JACK BINNS' **RADIO** DEPARTMENT

Reg U.S. Pat. Off.

Popular Science

FOUNDED **MONTHLY** 1872

Read How to Down the Demons of Waste and Double the Life of Your Car

How to Heat Your Home with 30 Per Cent Less Coal

CTOBER *Useful Designs for Mechanics and Tool Users* 25 CENTS

Cunningham tubes

The Heart of Your Home Receiving Set

AMPLIFIES AS IT DETECTS

—enjoy clear reception by using Cunningham Tubes

Cunningham Detector Tube, type C-300, insures clearest reception for all radio messages, concerts, press and weather reports.

The rigid specifications to which these tubes are built in the General Electric Laboratories determine their uniform operation and perfect clearness.

Cunningham Amplifying Tube, type C-301, is conceded to be the most efficient amplifier ever produced. For complex and multi-stage circuits, freedom from distortion and absence of all tube noises as well as for the operation of loud speaking telephones and devices requiring considerable power, this tube has no equal.

If your dealer cannot supply you, write us direct for the name of a Radio Dealer who can.

TYPE C-300
GAS CONTENT DETECTOR
$5.00

TYPE C-301
HIGH VACUUM AMPLIFIER
$6.50

PATENT NOTICE

Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08 and others issued and pending. Licensed only for amateur or experimental uses in radio communication. Any other use will be an infringement.

The trade mark GE is the guarantee of these quality tubes. Each tube is carefully inspected and tested before leaving the G. E. factory.

E. T. Cunningham

Trading as
AUDIOTRON MFG. COMPANY

248 First Street
San Francisco, Calif.

154 West Lake Street
Chicago, Illinois

NOW FREE!

The Book That Has Shown Thousands The Way To Amazing Salary Increases.

DO you want to leave the rut of routine work for a position that will grow daily in its fascination? Do you want to start right out making more money than you ever dreamed possible? We have done exactly this for thousands of men. Here is the book which gave them their start. Read how it is now offered to you—FREE!

TAKE this situation. A man who had worked all his life in a routine job at low pay suddenly surprises his friends by moving into a better neighborhood, taking a big house, buying a car and blossoming out as a well-to-do and influential citizen in his new community. How did he do it? What is the secret that he used? Simple enough. He knew that the biggest money in business is in Selling, and though he felt that he couldn't sell a thing, he suddenly learned the secrets that make Master Salesmen and then began to make big money.

If only one man had found inspiration enough in this remarkable book to jump to a sudden brilliant success in the Selling field—into a job paying him many times his former salary—then you might call it luck. But thousands have done it.

Your One Chance to Make the Biggest Money of Your Life

Not one of the men whose names appear below had ever sold a thing before—not a dime's worth. If you had told one of them that he could sell he would have laughed at you. Probably he would have come back with the old saw, "Salesmen are born, not made." They were frankly skeptical. Yet every one of these men, through reading this book, discovered the fallacy of this vicious old idea that Salesmen are "born." They learned *that Master Salesmen are made!* And in this book they found an amazingly easy way to jump suddenly from low pay to extraordinary earnings.

Simple as A B C

Sounds remarkable doesn't it. Yet there is nothing remarkable about it. There are certain ways to approach different types of prospects to get their undivided attention—certain ways to stimulate keen interest—certain ways to overcome objections, batter down prejudices, outwit competition and make the prospect act.

If you will learn these principles there is awaiting you a brilliant success and more money than you ever dreamed of earning. This book, "Modern Salesmanship" tells exactly how the National Salesmen's Training Association will make you a Master Salesman.

As soon as you are qualified and ready the Employment Service of the National Salesmen's Training Association will help you to select and secure a selling position as city or traveling salesman. Thousands of the biggest, most reputable selling organizations in America turn to this Association for their Star Salesmen.

Now Free to Every Man Who Will Act At Once

We are not making any extravagant claims about what we will do for you. We don't have to. The records of the truly amazing successes for which we are responsible are so overwhelming a testimonial of the fact that any man of average intelligence can become a Master Salesman that we are willing to leave the decision entirely up to you. All of this amazing proof and many important features about Salesmanship are contained in our salary raising book, "Modern Salesmanship." It is yours—FREE. Send the coupon for it today. It will show you how you can quickly become a Master Salesman—a big money maker. It will tell you about the National Salesmen's Training Association system of Salesmanship training that has meant prosperity to so many thousands of men—about the National Demonstration method that gives you actual experience while studying—and all about the amazing opportunities that await you in the selling field.

If you do not send this coupon we will lose merely the opportunity to train one more Master Salesman. But for you, failure to act may mean that you lose the one big chance of your life to leave forever behind you the low pay of a routine job. It may mean the difference between this and a sudden, brilliant success at a big salary. Is it worth 2c to find out? Then mail this coupon NOW.

NATIONAL SALESMEN'S TRAINING ASSOCIATION

Dept. 15-R

Chicago, Illinois

National Salesmen's Training Association
Dept. 15-R. Chicago, Ill.

I simply want to see the facts. Send me FREE your Book "Modern Salesmanship" and Proof that I can become a Master Salesman. Also tell how you can help me to a position and send list of lines with openings for Salesmen.

Name.....

Address.....

City.....State.....

Age.....Occupation.....

Read

Charles Berry of Winterset, Iowa, stepped from $18 a week as a clerk to a position making him $1,000 the very first month. J. P. Overstreet of Dennison, Texas, read this amazing book, left a job on the Capitol Police Force at a salary of less than $1,000 a year and in six weeks earned $1,800. F. Wynn, Portland, Ore., an ex-service man, earned $554.37 in one week. Geo. W. Kearns of Oklahoma City found in this book a way to jump his earnings from $60 a month to $524.00 in two weeks and C. W. Campbell learned from it how he could quit a clerking job on the railroad to earn $1,632 in thirty days.

POPULAR SCIENCE MONTHLY

OCTOBER, 1922; Vol. 101, No. 4
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

How to Double Your Car's Life

"EVERYBODY in America wants an automobile." It is less dangerous to make that generalization about the universal desire for a car than about almost any other semi-luxury. With over ten million automobiles in use, there are still more people that want cars of their own.

ASTONISHING price cuts in cars, this year, together with easy purchase plans, have put it within the power of thousands to buy something that runs on wheels. But fear of upkeep costs deters them from the purchase. And to ten million Americans who are already automobile owners the upkeep is also an exasperating factor of daily existence.

NOW, it costs the average American altogether too much to run his car. It is equally true that many a man who hesitates to buy because of upkeep costs would stop hesitating if he realized how these costs can be halved by careful attention to the car, backed by knowledge of its needs.

HOW to get more pleasure out of your car at less cost is made plain in a remarkable series of articles now appearing in POPULAR SCIENCE MONTHLY. The unseen demons of waste, pictured on our cover this month, cause the average owner of a low priced car something like $600 in needless expense. Know your car, learn how to take care of it, and you can save this wasted money. Many a man might actually double his car's life by downing these waste demons.

THE article by Harold F. Blanchard, on page 68 of this issue, his article on "Tuning Up the Car," appearing next month, and his article to appear in the December issue, telling how to save from 20 to 30 per cent in gasoline costs by proper carburetor adjustment, will be invaluable to the automobile owner and the prospective automobile purchaser.

CONTENTS

POPULAR SCIENCE MONTHLY

225 West Thirty-ninth St., New York City

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, $2.50; foreign countries, $3. Advertising rates on application. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

More Heat from Less Coal

THE problem of getting enough coal for this winter is vital in nearly every house in the land today. Whatever efforts are made to increase coal production this fall, it seems inevitable that we shall have to get along on short fuel rations. Coal economy becomes, therefore, a matter not only of money saving, but of actual physical comfort.

THE article on page 30 of this issue, written by one of the most successful heating engineers in the country, points out simple methods by which the average home owner can get more heat with less fuel. The results of important scientific research in heating problems, that are of the most intense interest to every reader, are here published for the first time outside of technical circles.

MAKING a small coal pile last longer, and getting more heat at less cost not only this year, but every year henceforward, will be easy for almost any man who is willing to use a few tools to make improvements in his home. Very few medium-priced houses are built as they should be to insure really efficient heating.

AN INFORMATIVE article on this topic with new drawings, to appear in the Home Workshop Department next month, will be of the most practical assistance to every householder.

DON'T miss Jack Binns' "Ten Commandments for Radio Users!" Beginning in the November issue, this feature will unquestionably be voted the most valuable radio material we have yet published. In this new series of articles, America's most popular writer on wireless topics gives simple advice for operating with the maximum efficiency the most commonly used types of radio receiving apparatus. With his help you will get better results from your radio set.

Do *YOU* Do Any of These Embarrassing Things?

The man in this picture has reason to be ill at ease. He has attended an informal dinner in conventional full dress. The Book of Etiquette would have told him how to interpret the word "informal" on the invitation—and would have revealed to him important things to know regarding an informal social function. The Book of Etiquette tells you what to wear on all occasions.

His friend has just introduced him to the young woman. Instead of waiting for her to offer her hand and make the acknowledgment, he has extended his hand first and mumbled confusedly something about being "Glad to meet you." By telling you how to make and acknowledge introductions, the Book of Etiquette prevents a great many embarrassing blunders.

She has just signed her name in the hotel register, and glanced at the names above. She sees, in these other signatures, that she has made a mistake—that she has registered incorrectly. Mistakes such as these can often be very embarrassing indeed. The Book of Etiquette prevents them, as it covers the whole subject of hotel etiquette completely and authoritatively.

Without realizing his mistake, the man in this picture has followed the head waiter, preceding the young woman. It is the wrong order of precedence, and he discovers it to his embarrassment only when he notices the entrance of another couple. The Book of Etiquette tells you about the mistakes that might be made, when entering the theatre, the street car, the drawing room. And it tells you how to avoid these humiliating blunders.

Every one knows that table manners are an index to breeding. The man in this picture has taken olives with a fork, and has just realized his error, as the others have taken them with their fingers. Too bad he didn't refer to his Book of Etiquette! It tells all about table manners—how to eat corn on the cob, lettuce, asparagus, frozen pudding.

The gentleman at the right does not know how to dance. Instead of doing what he should, under the circumstances, he is making himself conspicuous by standing alone while the others dance. The Book of Etiquette would have told him how to avoid this embarrassment—and would have told him also the complete etiquette of the dance and of dancing. It is a most fascinating chapter.

The Book of Etiquette Sent for FREE Examination

If you do not already own the famous two-volume set of the Book of Etiquette, send for a set at once that you may examine it at our expense. Don't be without it another week. It solves many little problems that may be puzzling you, tells you the right thing to do, say, write and wear on all occasions.

It costs you nothing to examine the Book of Etiquette. You are not obligated to keep the set if you are not delighted with it. You be the judge—just mail the coupon and let us send you the Book of Etiquette for free examination. But do it NOW!

NELSON DOUBLEDAY, Inc., Dept. 2510, Oyster Bay, N. Y.

NELSON DOUBLEDAY, Inc., Dept. 2510, Oyster Bay, N. Y.

I accept your free examination offer. You may send me the two-volume set of the Book of Etiquette free for 5 days. During that time I will examine the books, read some of the chapters, examine the illustrations. I understand that all phases of etiquette are covered—wedding etiquette; the etiquette of dress, of speech, of manners; dance, party, tea etiquette, etc. Within the 5 day free period I will either return the books or keep them as my own and send you only $3.50 in full payment. I need not keep the set unless I am delighted with it.

Name.....

Address.....

City..... State.....

☐ Check in this square if you want these books with the **beautiful full leather** binding at $5.00, with 5 days' examination privilege.

QUICK-ACTION ADVERTISING

HERE READERS AND ADVERTISERS MEET TO TRANSACT BUSINESS

Rate 25 Cents a Word. Advertisements intended for the December issue should be received by October 1st

AUTOMOBILES AND ACCESSORIES

PATENTS—Write for free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch and description of invention for our opinion of its patentable nature. Highest reference. Reasonable terms. Victor J. Evans & Company, 189 Ninth, Washington, D. C.

AMERICAN Garage & Auto Dealer publishes each month interesting and helpful suggestions and information on sales, merchandising, advertising, business management, accounting, welding, cutting, brazing, practical and progressive hints for office and shop, for "small-town" automotive dealers, garagemen, repairmen, mechanics. Subscription price $1.00 per year. (Money back if not satisfied.) Sample copy on request. American Garage & Auto Dealer, 1005 Lake View Building, Chicago.

PROTECTION from the Wind, Dust, Rain and Snow. Use "Wear Me" Windshield Wings and motor with pleasure. Fully Guaranteed. Money back if not satisfied after ten days use. Regular Set $12.50, Ford Special $10.00. Wear Me Auto Specialty Company, 1602 Broadway, Pittsburgh, Pennsylvania. See "Ad" page 104.

FREE sample, Tepee Liquid Auto Gloss. Easily applied. Dries quickly giving rich lustrous finish. New life to the old paint. Rosebud Chemical Co., Forsyth, Mont.

AUTOMOBILE Mechanics, Owners, Garagemen, Repairmen, send for free copy America's Popular Motor Magazine. Contains helpful instructive information on overhauling, ignition wiring, carburetors, batteries, etc. Automobile Digest, 513 Butler Building, Cincinnati, Ohio.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

FORD ACCESSORIES

CYCLO "Dynamic" provides remarkable solution of hot-spot problem. Cyclo Manifold Co., Chestnut St., Akron Ohio.

LIFE size "red-i-kut" sureFit patterns with simple illustrated instructions make Ford sport car building easy. The fast saucy "Pal" patterns with pressed metal streamline rear only $6.40 complete and delivered. Send for prospectus on making sport bodies—"Jiffy Tops"—"Gosum" Windshields. Kuempel Co., 96 Kuempel Bldg., Guttenberg, Iowa.

ELECTRICAL

ELECTRICITY for 10c per hour. Motsco auto generator. Operates on any make automobile. Produces electricity for moving picture machines, theatres, schools, churches, homes, etc. Write for free particulars. Monarch Theatre Supply Co., Dept. AG 724 South Wabash Avenue, Chicago.

WANTED

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

CASH for old gold, platinum, silver, diamonds, Liberty Bonds, war, thrift, unused postage stamps, false teeth, Magneto Points, jobs, any valuables. Mail in today. Cash sent, return mail. Goods returned in ten days if you're not satisfied. Ohio Smelting Co., 309 Hippodrome Bldg., Cleveland, Ohio.

WANTED—Representatives in every Factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

DUPLICATING SERVICES

"MODERN" Duplicators save Time, Labor and Money. Gets Business. Reproduces Typewritten or Penned Letters, Drawings, Lessons, Music, Menus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints TWO per minute. Special Sale On. 30 Days Free Trial. $2.25 up. Booklet Free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

TRADE SCHOOLS

DENTAL laboratory work quickly taught through individual instruction. Our graduates in great demand, earn $1500 to $6500 yearly. Earn while you learn. Send for Bulletin 4 McCarrie School of Mechanical Dentistry, 34 West Lake Street, Chicago.

EARN more money—Learn sign painting, scenic painting, showcard writing, auto painting, paper hanging, decorating, graining, marbling, at Chicago or at your home. Chicago Painting School, 157 West Austin Avenue, Chicago.

LABORATORY AND CHEMICAL SERVICE

YOUR problem solved for Five Dollars. Write me. W. Stedman Richards, Consulting Chemist, Box 2402, Boston, Massachusetts.

TELEGRAPHY

TELEGRAPHY—(Morse and Wireless) and railway accounting taught thoroughly. Big salaries, great opportunities. Oldest, largest school. All expenses low—can earn large part. Catalogue free. Dodge's Institute, Queen Street, Valparaiso, Indiana.

BOATS AND LAUNCHES

16-FOOT rowboat. Easily made. Construction blueprint, 30c. Wee-Sho-U Co., 41-S, West Market, Detroit, Michigan.

MANUFACTURING

WE manufacture anything, design and build special machinery, develop inventions, build models, make drawings of every description, our facilities the best. Write for booklet. R. G. Clyne Engineering Co., St. Louis, Missouri.

LET us manufacture that part or article for you. Victor Engineering Co., 2524 W. Chicago Avenue, Chicago, Illinois.

TO Order Metal Articles, models, tools, patterns, experimenting, manufacturing, inventions developed. Cleveland Specialty & Manufactiring Co., Searsdale Avenue, Cleveland, Ohio.

ADDING MACHINES

FREE trial, marvelous new adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals $350.00 machine. Price only $15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write to-day for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Mich.

Here's Proof Positive of Good Results

When an advertiser uses one insertion in a magazine—or even two—and then stops, it is natural to assume that the investment wasn't a paying one. But when a well established mail-order concern keeps using space month after month, year after year, without omission, it is proof positive of good results. For such an advertiser invariably keeps a careful record of returns and if it didn't pay, they wouldn't stay. Here's what we mean:

Popular Science Monthly,
New York City.
Gentlemen:

Your magazine has always proved a favorable medium. It places us in contact with persons of general intelligence, who mean business and who have the means to carry out their ambitions.

The fact that we long ago authorized our advertising agency to carry our account with you on a "t. f." basis is proof of the high estimation in which we regard your magazine.

Yours truly,
National Literary & Publishers' Service Bureau.

Why don't YOU try the next issue? At 25 cents a word, with a circulation of over a quarter of a million, you cannot afford to ignore this market. Just drop us a line and we'll give you the facts. Thank you.

Classified Advertising Manager
POPULAR SCIENCE MONTHLY
225 West 39th Street
New York City

FORMULAS

FREE—Formula catalog. Laboratories, 4600 Boylston Building, Chicago.

3000 FORMULAS and recipes—400 pages. $1.00. Englewood Book Shop, 7021D South Winchester, Chicago.

FORMULA catalog free. C. A. Lutz, Apartment 241, York, Pennsylvania.

FORMULAS of the better sort. Write for our free catalog. Thos. Steel, President, 622 Main, Richmond, Virginia.

1,000,000 formulas, trade secrets, processes, $2.00. Jay-Hershberger, 9B602, Kokomo, Indiana.

RADIO SUPPLIES

WONDERFUL Invincible Crystal Radio Set. Complete with Head Phone and Ducon Plug. Fits any electric socket. No outside antenna necessary. $20 Prepaid. Reliable Agents Wanted. Invincible Products Co., 150 North State Street, Chicago.

WESTINGHOUSE and other standard radio sets and parts. Liberal commissions paid for interesting others which enable you easily to earn your set and make money. Write for price list and proposition. Wheeler-Thomas Radio Co., Dept. 28, Holland, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

MOTORCYCLES, BICYCLES, SUPPLIES

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

PARTS for all motorcycles cheap. Schuck Cycle Co., 1922 Westlake, Seattle, Washington.

USED and new parts. Indian, Excelsior, Harley, Reading, Thor, Henderson, Yale. Get our price lists. Kingshighway Cycle Co., 1166 North Kingshighway, St. Louis, Missouri.

LARGEST stock of new and used motorcycle parts and accessories in the world at your disposal via Uncle Sam's mail. Write for quotations. Motorcycle Parts Mfg. Co., 2030-36 Wabash Avenue, Chicago, Illinois.

STAMPING NAMES

MAKE $19.00 hundred stamping names on key checks. Send 25c for sample and instruction. P8 Keytag Company, Cohoes, New York.

AMERICAN MADE TOYS

INCREASE your output of metal toys and novelties by using a casting form hand machine. Write for cicular T-5, V. G. Clute, Mechanicsville, New York.

AVIATION

PROPELLERS for aeroplane propulsion, small propellers for motorcycle driven snow and ice sleds, road speedsters, and hydroplanes, 5 foot diam. $12, 6 foot diam. for Fords $15, others in proportion, hub mountings, bearings, sprockets, and countershafts complete, full scale blue prints for building motorcycle sleighs 75c., Ford type $1.00. Crawford Motor and Aeroplane Manufacturer, Longbeach, California.

INVENTORS desiring information write for our free Illustrated Guide Book and Evidence of Conception Blank. Send model or sketch of invention for our opinion of its patentable nature. Highest references. Prompt service. Reasonable terms. Victor J. Evans & Company, 151 Ninth, Washington, D. C.

MODELS AND MODEL SUPPLIES

WE make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MODEL making and experimental work; modern shop, expert workmen. Manufacturing. Lamson Model and Experimental Works, 625 W. Jackson, Chicago.

FOR THE HOME

ORDINARY door locks made absolutely burglar-proof by simple device. Set for three doors, $1.00. H. Groesbeck, 230 Fourth Ave., Salt Lake, Utah.

HOME Builders Guide, 35 house plans price $1. L. Bjostad, Architect, 4 Palladio Building, Duluth, Minnesota.

GRANDFATHER clock works, $5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

FOR BOYS

MOUTH-ORGAN Instructor, 25c. Play in one hour. Elsea Publisher, Bowling Green, Ohio.

ASTROLOGY

MAGIC words! Secret; sure method of obtaining your desires. Postpaid for dime. Smedley, 145 Miller, Brooklyn, N. Y.

ASTROLOGY Reveals. 2000 word trial reading 25c; two questions free. State Birthdate. Prof. Audrey, Desk D, Departmental Bank Bldg., Washington, D. C.

HOROSCOPES

YOUR heroscope covering full year, 35c. Includes extensive reading, valuable daily guide, large pictorial chart and special forecasts for each month. Scientific, complete. Try it! Money back if dissatisfied. Give birthdate. Address L. Daniels, Flatbush Station, Box 32, Brooklyn, New York.

YOUR horoscope, business, changes, social, matrimonial prospects. Send birthdate and 10 cents (stamps) for remarkable test reading. Zanya, 202-G, West 105th Street, New York.

SAFETY RAZORS SHARPENED

BLADES resharpened 3c, any make. Guaranteed service. Standard Safety Razor, Pittsburgh, Pennsylvania.

Quick-Action Advertisements continued on page 6

BUILDING TRADES NEED TRAINED MEN!

Thousands of Good Positions at Good Salaries

THE business tide has turned! And the building trades are leading the way back to prosperity!

Building contracts made to July 1 of this year are the largest in number and in value ever awarded in any six months in this country's history. Government experts estimate that more than four billion dollars will be spent for construction this year.

And this is only the beginning of a building campaign that must last for years. There is a shortage of more than a million homes, and half a million more are needed each year to provide for normal growth.

"It will take us 12 years, working 25 per cent above normal," says John Ihlder, Manager of the Civic Development Department of the United States Chamber of Commerce, "to provide as adequately for our population as before the war."

Thousands of schools, churches, hospitals, banks, office buildings, warehouses, grain elevators and public buildings are needed and must be built. Millions of dollars will be spent in the building of roads and bridges.

Trained men needed

Today the most vital need of this great building program is men—trained men—men who can step right in and do the skilled work that building construction requires. Those needed most are draftsmen, architects, foremen, contractors, structural engineers, concrete engineers, surveyors, mechanical engineers, civil engineers, electricians.

Right now there is a shortage of men in these skilled trades and professions. E. J. Brunner, Editor of the American Contractor, says: "The construction industry is reaching out with a fine-tooth comb for all available skilled mechanics of the building trades."

If this situation exists *now*, think what it will be six months, a year, two years hence, when other industrial activities are back to capacity and men cannot be drawn from other fields.

Do you realize what this means to *you?* It means that if you are now employed on construction work, you can, through special training, qualify for advancement to more important and more responsible work at a greatly increased salary, or prepare to establish yourself in your own business.

It means that if you are now in other work, but would like to get into building construction, you can start immediately. The best plan is to take up the study of that branch of building which interests you most. Devote your spare time to it. In a surprisingly short while you will have learned to do some one definite kind of work that most men cannot do at all. And in almost every community you will find builders or contractors or architects who will be glad to pay you well for doing that special work for them.

There is a simple, easy, fascinating way by which you can prepare for a good position, at good salary. You can do it right at home, in spare time, no matter where you live, through the International Correspondence Schools.

There is no question—no doubt about this. For thirty years the I. C. S. has been training men for advancement in the building trades and in more than three hundred other business and technical subjects.

A recent investigation of 13,298 students enrolled in I. C. S. Building Trades Courses showed that

1291 had become Architects
246 had become Designers
494 had become Chief Draftsmen
2827 had become Draftsmen
1845 had become Contractors
211 had become Assistant Foremen
4030 had become Foremen
2354 had become Superintendents

IN every instance these students reported salaries or independent incomes far greater than when they took up their studies. Many have shown increases of 300% to 500%. Some have incomes as high as $25,000 per year.

The Equitable Building, New York, was erected under the direction of I. C. S. Student H. S. Gardner, then Superintendent of Construction for the Thompson-Starrett Company.

The Classical High School, Lynn, Mass., was built by I. C. S. Student George H. Stowe.

The Kansas State Memorial Building, Topeka, was designed and erected by I. C. S. Student C. H. Chandler, then State Architect of Kansas.

The Pacific Building, San Francisco, largest reinforced concrete building in the world, was built under the direction of I. C. S. Student Erik Holman.

George A. Grieble, who was a stone-mason by trade, decided to win success in construction work and took an I. C. S. Course. Today he is a member of the Grieble Company, Cleveland, earning $12,000 a year. In one year his firm erected buildings worth $6,000,000.

These men won success under conditions less favorable than those that surround you today. Now there is a need for skilled men more urgent than the building trades have ever known.

Your chance has come

You can have the position you want in the work you like best, an income that will give you and your family the home, the comforts, the luxuries you would like them to have. No matter what your age, your occupation, or your means, you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark the work you would like best in the coupon below and mail it today. There is no obligation and not a penny of cost. It takes but a moment, but it is the most important thing you can do today. Do it now!

— — — — — — TEAR OUT HERE — — — — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7605-C, Scranton, Penna.

Without cost or obligation, please send me your 48-page booklet, **"Who Wins and Why,"** and full information about the subject before which I have marked an X in the list below:

TECHNICAL AND INDUSTRIAL DEPARTMENT

- ☐ Architect
- ☐ Architectural Draftsman
- ☐ Blue Print Reading
- ☐ Building Foreman
- ☐ Concrete Builder
- ☐ Contractor and Builder
- ☐ Structural Draftsman
- ☐ Structural Engineer
- ☐ Electrician
- ☐ Electrical Engineer
- ☐ Electrical Contractor
- ☐ Electric Wiring
- ☐ Mechanical Engineer
- ☐ Mechanical Draftsman
- ☐ Machine Shop Practice
- ☐ Toolmaker
- ☐ Civil Engineering
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- ☐ Gas Engine Operating
- ☐ Automobile Work
- ☐ Airplane Engines
- ☐ Plumber and Steam Fitter
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- ☐ Foreman Plumber
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- ☐ Steam Engineer
- ☐ Railroad Positions
- ☐ Chemistry
- ☐ Pharmacy
- ☐ Metallurgy
- ☐ Mining Engineer
- ☐ Navigation
- ☐ Mathematics ☐ Radio

BUSINESS TRAINING DEPARTMENT

- ☐ Business Management
- ☐ Industrial Management
- ☐ Personnel Organization
- ☐ Traffic Management
- ☐ Business Law
- ☐ Banking and Banking Law
- ☐ Accountancy (including C.P.A.)
- ☐ Nicholson Cost Accounting
- ☐ Bookkeeping
- ☐ Business English
- ☐ Private Secretary
- ☐ Business Spanish
- ☐ French
- ☐ Salesmanship
- ☐ Advertising
- ☐ Better Letters
- ☐ Foreign Trade
- ☐ Show Card Lettering
- ☐ Stenography and Typing
- ☐ Teacher
- ☐ Civil Service
- ☐ Railway Mail Clerk
- ☐ Common School Subjects
- ☐ High School Subjects
- ☐ Illustrating
- ☐ Cartooning

Name.....
Street Address.....
City..... State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

OFFICE DEVICES

ADDRESSING machines, multigraphs, duplicators folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 170-Z North Wells, Chicago.

MISCELLANEOUS

RAZOR Blade Pocket Knife—Money easy made by selling a handle for an old discarded safety blade. Sample mailed to agents on receipt 25c coin or stamp. A. Tubbs & Company, 66 Plummer, Hammond, Indiana.

MAKE interesting new friends and receive jolly letters! Send Stamp. Betty Lee, Incorporated, 4254 Broadway, New York City.

MONOGRAMS—for automobiles, ivory sets, bags, trunks, canoes,—6 initials, instructions, 75c. Wregg, Lyndhurst, New Jersey.

RUBBER stamps. Your name and address, 20c. Rubber Stamp Shop, Muncie, Indiana.

ADVERTISING

PUT your advertising problems up to those who know. As president of the advertising agency of Douglas Wakefield Coutlee, Inc., New York, I have conducted campaigns for many of the national advertisers of America. What I have done for others I can do for you. And by doing it in my spare time you'll get maximum results at minimum cost. Letters, folders, booklets, advertisements written and illustrated. Explain your needs in first letter. Reference—R. G. Dun, any magazine or newspaper. Address: Douglas Wakefield Coutlee, 906a Park Avenue, Woodcliff, New Jersey.

FREE AD-Guide giving interesting rates for advertising in magazines and weeklies. Concordia Magazine, 2DW, York, Pennsylvania.

ADVERTISE in 24 metropolitan dailies, 25 words, $15. Helpful Guide listing 1000 publications, 4c stamps. Wade, Baltimore Bldg., Chicago.

INCH Display Advertisement, 161 Magazines, thrice $15.00. Wood's Popular Services, Atlantic City.

ADVERTISEMENTS, letters, circulars, folders, booklets, convincingly written and attractively designed: any subject; 20 years' resultful experience; my book, "Direct Advertising" free. Ernest F. Gardner, 520-A Ridge Arcade, Kansas City, Missouri.

ADVERTISING letters, booklets, circulars composed. Quinan, 5404 Lansdowne Avenue, Philadelphia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York

WORK WANTED

PUNCH Press work, tool and die making model, and special machine work wanted. Completely equipped with new machinery of the latest type. Prompt delivery, reasonable prices guaranteed. Quality & Machine Co., Dept. B, 6154-56 N. Clark St., Chicago.

PATENTS FOR SALE

FOR sale—Patent expansible steel rim split pulley, J. Muller, 1843 Norman Street, Brooklyn, New York.

SCENERY FOR HIRE

SETTINGS for Opera, Plays, Minstrels. Plush Drops. Catalog. Amelia Grain, Philadelphia.

PRINTING, ENGRAVING, MULTIGRAPHING

LETTERHEADS, envelopes, 500 $2.65. Samples free Quality Printery, Marietta, Ohio.

100,000 1 x 2" labels, $33.00. 3,000, $2. Save 30% Wolf Labels, Station E, Philadelphia.

BETTER printing for less money! Send for our large package of samples of hundreds of items every user of printing is interested in. These samples worth dollars will be sent for 10 cents to pay postage. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

EMBOSSED business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

VISITING cards, 65c 100; case included. Letterheads, $4.00 1000. Reitzel, 622 Penn, Lancaster, Pennsylvania.

LOWEST prices on advertising. Pencils in quantity. Sample, with your Ad imprinted in gold, 10c. S. Musial & Co., 425 Walnut Street, Yonkers, New York.

200 letterheads and 20 envelopes, $1.00, postpaid. Echo, Wauwatosa, Wisconsin.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

POULTRY AND LIVE STOCK

BREED squabs. Book free. C. Rice, Melrose Highlands, 77, Massachusetts.

SPENCER turken—half turkey, half chicken. Photos, booklet, free. Spencer, R. 1, Santa Cruz, California.

PHONOGRAPHS, RECORDS

BUILD your phonograph. Quality phonoparts. Highest quality spring and electric motors, tone arms, reproducers, amplifiers, case material and accessories. Free blue prints and building instructions. Big saving. Wonderful results. New catalog mailed for ten cents. Hoosier Manufacturing & Supply Co., Phonograph Supply Department, 316 Baldwin Block, Indianapolis, Indiana.

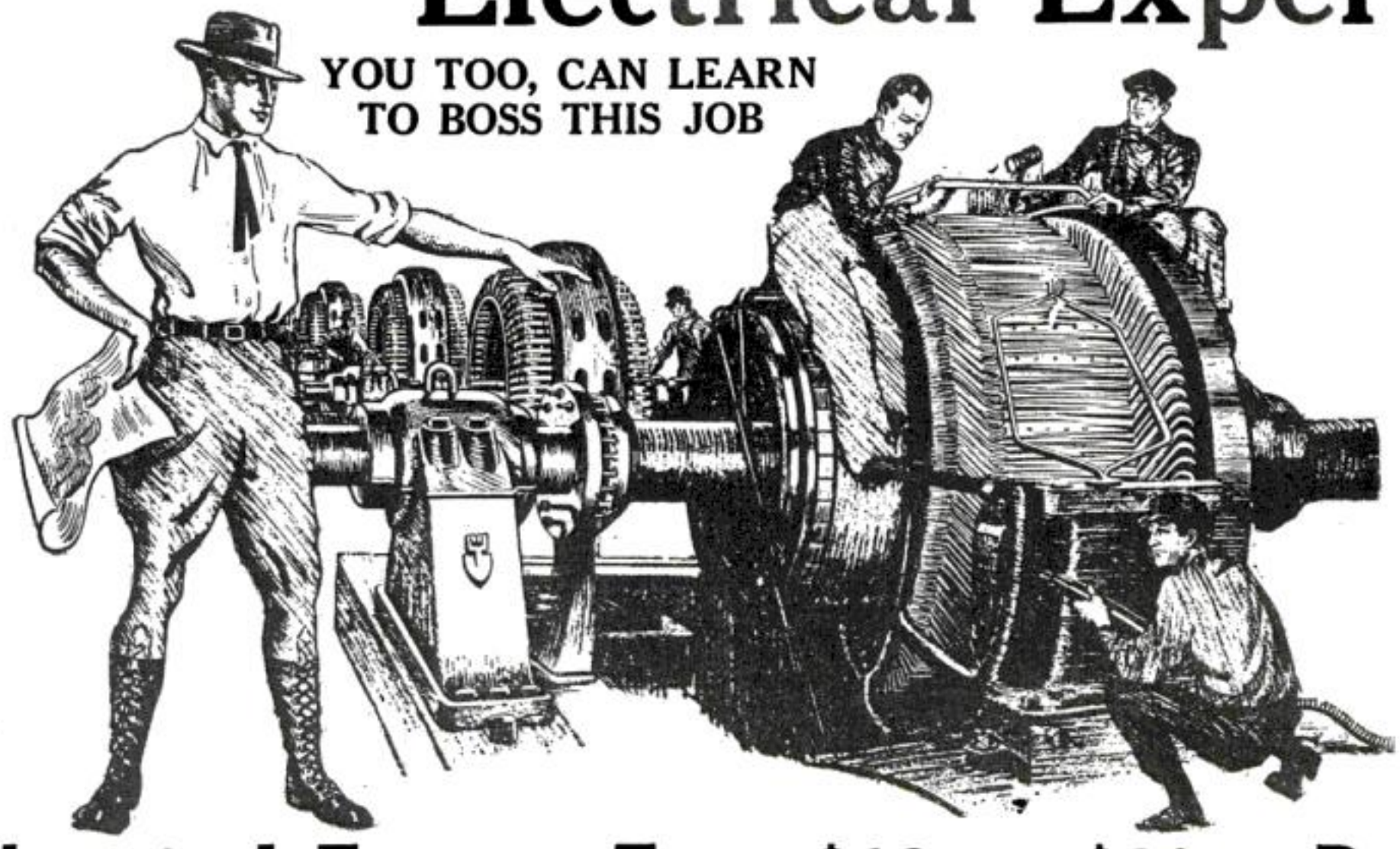
CHALK TALKS

LAUGH producing program, $1.00. Circulars free, Cartoonist Balda, Oshkosh, Wisconsin.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising Popular Science Monthly, 225 West 39th Street, New York

Quick-Action Advertisements continued on page 8

Be a Certificated Electrical Expert



Electrical Experts Earn $12 to $30 a Day

Trained "Electrical Experts" are in great demand at the highest salaries, and the opportunities for advancement and a big success in this line are the greatest ever known.

"Electrical Experts" earn $70 to $200 a week. Fit yourself for one of these big paying positions.

Be an "Electrical Expert"

Today even the ordinary Electrician—the "screw driver" kind—is making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the "Electrical Expert"—who is picked out to "boss" ordinary Electricians—to boss Big Jobs—the jobs that pay.

Earn $3,500 to $10,000 a Year

Get in line for one of these "Big Jobs" by enrolling now for my easily-learned, quickly grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Draw-Back

You don't have to be a College Man; you don't have to be a High School graduate. My Course in Electricity is the most simple, thorough and successful in existence, and offers every man, regardless of age, education, or previous experience, the chance to become, in a very short time, an "Electrical Expert," able to make from $70 to $200 a week.

Some Features of My Course That Make Your SUCCESS Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory
2. Free Electrical Outfit—Finest outfit ever sent out for home experiment and practical use.
3. Free Employment Service. (Helps you get a good job.)
4. Free Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Engineering Magazine.
6. Free use of my Electrical Laboratory.
7. Extra Courses Free—Radio—Electrical Drafting.
8. Spare time work—special earn-while-you-learn lessons.
9. All supplies and material furnished free.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book.

I Give You a Real Training

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to get the best positions at the highest salaries. Hundreds of my students are now earning $3,500 to $10,000.

Many are now successful ELECTRICAL CONTRACTORS.

Your Satisfaction Guaranteed

So sure am I that you can learn Electricity—so sure am I that after studying with me, you, *too*, can get into the "big money" class in electrical work, that I will guarantee under bond to return every single penny paid me in tuition if, when you have finished my course, you are not satisfied it was the best investment you ever made.

FREE—Electrical Working Outfit—FREE

I give each student a Splendid Outfit of Electrical Tools, Materials and Measuring Instruments absolutely FREE. I also furnish them with all supplies, examination paper, and many other things that other schools don't furnish. You do PRACTICAL work—AT HOME. You start right in after the first few lessons to WORK AT YOUR PROFESSION in a practical way.

SAVE $45.50 BY ENROLLING NOW

You can save $45.50 in tuition by enrolling now. Let me send you full particulars of my great Special Offer, and my Free booklet on "How to Become an Electrical Expert."

L. L. COOKE

Chief Engineer

Chicago Engineering Works

Dept. 37, 2150 Lawrence Ave., Chicago, Ill.

L. L. COOKE, Chief Engineer
Chicago Engineering Works
Dept. 37, 2150 Lawrence Ave.
Chicago, Ill.

Dear Sir: Send me at once full particulars of your great Special Offer, including the "Vital Facts," sample lessons and your big Free booklet on "How to Become An Electrical Expert." No obligation on my part.

Name.....

Address.....

.....

The "Cooke" Trained Man is the "Big Pay" Man

Student Winding a Stator

Learn Electricity

In 3½ Months

THE whole world of electricity is open to the Coyne trained man. He is trained completely. He can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or he can go into business for himself as electrical contractor, dealer, auto ignition or battery expert and make from $3,000 to $20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

Big New Home of the Great Shops of COYNE

The increased popularity of Coyne and a tremendous influx of new students simply forced us to move into larger and more spacious quarters. Here, in the big, new home you will find added electrical equipment—new and larger departments—a more complete electrical training.

Earn $150 to $400 Per Month

No books or useless theory. You are trained on $100,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switchboards, power plants—everything to make you an expert ready to step right into a position paying from $45 to $100 a week. Learn electricity in the electrical center of the world. Send coupon today for free catalog.

Radio Course FREE

We include the following free with the regular course:

(1) A complete course in auto, truck and tractor electricity and storage batteries. Greatest outlay of auto electrical and battery equipment in the country.

(2) Course in Radio—the marvel of the age. Constructing, installing and operating. You can build your own wireless telephone set.

(3) A life scholarship in the Coyne school. You can stay as long as you wish and return for further training at any time in the future.

EARN WHILE YOU LEARN. We help students to secure jobs to earn a good part of their expenses while studying.

Send Coupon Now!

Don't delay a minute—send that coupon in **right now** for our big free catalog and full particulars of this wonderful offer. Act now!

B. W. COOKE, President
Coyne Trade and Engineering School
Dept. 30 1300-1310 W. Harrison St. Chicago, Ill.

B. W. COOKE, Pres., Coyne Trade and Engineering School
Dept. 30 1300-1310 W. Harrison St. Chicago, Ill.

Dear Sir: Please send me free your big catalog and full particulars of your special offer of three extra courses.

Name.....

Address.....

.....

EDUCATIONAL AND INSTRUCTION

CORRESPONDENCE school courses only one quarter original price. Send for free price list 1000 courses. Used courses bought. Students' Exchange, 47 West 42d Street, New York.

BOOKKEEPING in a week. Dukes, 1857-59 Walton Avenue, New York.

DOUBLE entry bookkeeping mastered in 60 hours; guaranteed; diplomas. International Bookkeeping Institute, Springfield, Missouri, Desk 10.

LINCOLN-JEFFERSON University. Home study in Academy College, Theological, Law, Music, Pharmacy, Business and Graduate schools, leading to degrees. Box G, 64 W. Randolph Street, Chicago.

USED correspondence courses rented. Courses bought. J. J. Henderson, 154 Ridge Ave., Yonkers, New York.

LEARN Architectural Drafting. Big pay. Opportunities everywhere. Practical, inexpensive instruction. Easy payments. Write now. Designer Evers, Englewood B, Denver, Colorado.

USED correspondence courses bought and sold. My prices are the lowest. A. J. Brooks, Hookset, New Hampshire.

HYPNOTISM easily learned. Lessons Guaranteed. Postpaid $1.10. Smith Publishing Co., Springfield, Mass.

CORRESPONDENCE Courses. Bargain prices. Bulletin 1064 free. Used Courses bought. Instruction Correspondence Exchange, 1966 Broadway, New York.

DEVELOP your psychic powers and become a spirit medium. Instructive lesson free. Address Occult, Box 1331, Tampa, Florida.

LANGUAGES

WORLD-Romic System, Masterkey to All Languages. Primers, 15 languages, $1.94 each language: Arabic, Chinese, Danish, Dutch, English, French, German, Italian, Japanese, Panjabi, Polish, Portuguese, Russian, Spanish, Swedish. Pronunciation-Tables, 80 languages, 30c each language. Languages Publishing Company, 8 West 40th Street, New York.

GAMES AND ENTERTAINMENTS

YOU'LL have lots fun exchanging cheery letters in my club. Eva Moore, Box 908, Jacksonville, Florida. (Stamp.)

TRICKS, jokes, magic, puzzles. Catalogue free. Clifford Fenner, 2401 Jefferson, Louisville, Kentucky.

FOR MEN AND WOMEN

GENUINE Indian baskets and wampum—wholesale. Catalogue. Gilham, Kelseyville, California.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

"SEXUAL philosophy," 12c. Clear, specific, authoritative, complete, best, satisfies. Fred B. Kaessmann, Lawrence, Massachusetts.

ARE you interested in the practical effects of Vibration and Color upon your life? It will pay you to answer this. Instructive literature free. Robert Knox, Box 728, San Francisco, California.

CIGARS, CIGARETTES, TOBACCO

HOMESPUN smoking tobacco—5 lbs. $1.00; 10 lbs. $1.75; 20 lbs. $3.25. Farmers' Union, Mayfield, Kentucky.

PHOTOGRAPHY AND SUPPLIES

FILMS developed 5c roll, prints 3c each. Photo Service, 929 McMillan, Cincinnati, Ohio.

SPECIAL Trial Offer: Any size Kodak film developed for 5c; prints 2c each. Over-night service. Expert work. Roanoke Photo Finishing Co., 212 Bell Ave., Roanoke, Virginia.

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 156 Camera House, Boston, 17, Massachusetts.

MAKE money with your camera. Booklet free. Lancaster, 409E Wright-Callender Building, Los Angeles, Calif.

FILMS Developed 5c roll—prints 3c each. Not ordinary kind—special studio finished. Reliable Studio, Station D, Cincinnati, Ohio.

KODAK finishing. Kodak, camera repairing. Developing and printing for amateurs. One day service. Complete line of photo supplies. Write Radium Studio No. 22, 847 Belmont, Chicago.

KODAK Prints 3c. Developing 5c. Postcards 5c. Altine Photo Co., Dept. W, 1982 Kinney, Cincinnati, Ohio.

AUTHORS—MANUSCRIPTS

WRITE for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 400, St. Louis.

WRITERS: Have you a song-poem, story, photoplay, to sell? Submit manuscript now to Music Sales Company, 48, St. Louis.

WRITERS: Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

FREE to writers—a wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely free. Just address Author's Press, Dept. 15, Auburn, New York.

$$$ FOR Ideas. Photoplay plots accepted any form; revised, criticised, copyrighted, marketed. Advice free. Universal Scenario Corporation, 904 Western Mutual Life Bldg., Los Angeles.

FOR SALE

LUGER pistols, barrels 4" to 16": Mauser pistols, long barrels: holster-stocks for both. Super accurate Mauser, Springfield and Mannlicher rifles. Catalogue, ten cents in stamps. Pacific Arms Corporation, San Francisco.

MUSICAL INSTRUMENTS

RAG jazz piano, saxophone or tenor banjo in 20 lessons. Christensen Schools in most cities, or learn by mail. Write for booklet or money-making teacher's opportunity. Christensen School, 22 E. Jackson, Chicago, Illinois.

California

has a job for You

Come to sunny California, to Los Angeles, the city of your dreams.

Learn Auto Trades In Coast's Biggest Schools

We'd like to take every page of this magazine to tell you how National Automotive has helped thousands of men to big pay auto jobs in California; how YOU can get a good job and earn big pay after a few short weeks training.

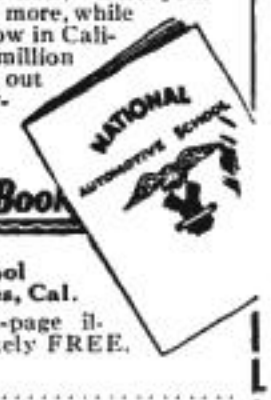
But we've told the story in a great big wonderful illustrated auto book. Send for YOUR copy—it's FREE.

Your Success Is Sure After NATIONAL Training

Hundreds of men write: "I have increased my earnings 100%." "I have built a wonderful garage business, and owe it all to National." "I am well satisfied with National training; am sending my brother to take the course."

It's the National practical shop training that counts. Actual construction work on all types of motors. Ignition, battery and lathe work—driving and vulcanizing. Special advanced electrical course FREE. You KNOW autos when you complete the NATIONAL course.

Special Low Tuition offer now. Earn your room and board, and a little more, while learning. Living expenses low in California—and it's worth a million dollars to live there. Find out about everything in interesting illustrated auto book. Mail the coupon now.



Send for Free Auto Book

National Automotive School
824 S. Figueroa, Los Angeles, Cal.

Please send me your 72-page illustrated auto book—absolutely FREE.

Name.....

Street No. .....

City..... State.....

My new plan brings this man $10.76 an hour!

L. G. Sprindler of Akron, Ohio, made $10.76 an hour the first time out! Almost took him off his feet! My men and women are cleaning up all over! **Gust Belgay made $52.00 in one day! E. T. Oliver sold $30 in two hours. W. E. Gibson took 69 orders in 2 days. W. H. Marion got 36 orders from 40 calls.** Why? The merchandise. It sells itself and you make over 100 per cent profit.

An Amazing Opportunity

I will positively show you the biggest selling profits and opportunities that any manufacturer has been able to offer you. No training. No experience. The quality holds your customers, thus you are building a permanent, sound business that will keep you financially independent.

Just Send Me Your Name

Just write me at once for full details of my proposition. There is no obligation—and it will mean real money for you. It's an honest to goodness opportunity! Write me this minute while you think of it. You'll never regret it.

E. M. DAVIS, Dept. 1360 Chicago

E. M. Davis, Dept. 1360 Chicago

Please send me full particulars of your new sales plan—and proof that there's big money in it.

Name .....

St. No. .....

Town..... State.....

Quick-Action Advertisements continued on page 10

It pays to read Business Books

THE Big Pay Men in every business are the accountant, the financial manager, the production manager and the sales manager. How did these men get to the top? How are they holding their jobs? There is just one answer to both questions. The "BIG 4" are readers of business books. With these books they keep abreast of the times. If there is a newer and better way of doing things they soon know about it and put the new method to use. Today every successful business man has, in his library of up-to-date business books, a Silent Partner.

Here is Your Silent Partner

Let this 8 volume Business Management Library be your Silent Partner. It is the newest and most comprehensive set of business books ever put on the market. It makes you familiar with all modern methods and shows you how to apply them in solving your own particular problems. It combines the sound principles of long standing with the new methods discovered and worked out during the late reconstruction period. It takes the cognizance of none but well established practical methods. This set is divided into 4 parts: Sales and Advertising, Production, Accountancy and Finance. Each part is complete in itself in 2 volumes. There is no overlapping or duplication between the different parts but through each part goes the common key note of managerial control.

Theory and Practice of Accounting

Its Use in Managerial Control

The majority of accountants bite their teeth out on business mathematics and do not digest the much more important knowledge of managerial control. As a result they do not know the policies and aims of the other three divisions in their business and fail in giving cooperation. In this work the value of correlations and how to obtain it is thoroughly explained. These two volumes contain about 500 pages, well illustrated with charts and diagrams. The author is Sturgeon Bell, M. B. A., Professor of Accounting, University of Texas.

Financial Management

Outline of Its Principles and Problems

There are many ways to finance a business. But which one is the correct method for your particular business? That question has been answered disastrously by many a concern these last three years. Take for instance that eastern concern making watches. Old fashioned financing—and that alone—put it into bankruptcy. A careful study of this part of Business Management could have saved the firm. This part is in 2 volumes of about 500 pages and much illustrated matter. Its authors is James McKinsey, A. M., L. L. B., C. P. A., member of the firm of Frazer & Torbet; author "Bookkeeping and Accountancy" and "Budgetary Control."

Production Management

An exceptionally helpful work in which the psychology of production is put to practical use. Contains many new methods which up to now have never been published although they are in use in some of the most successful plants in the country. The author shows that most so called common sense is but dangerous guesswork. This part comes in 2 volumes of about 500 pages, many charts and descriptive illustrations. It was written and compiled by A. M. Simons, B. L., author of "Personal Relations in Industry," "Social Forces in American Industry;" Director Foreman Training, American School; formerly Lecturer of Personnel Relations in the Extension Dept. of the University of Wisconsin and Manager Personnel Dept. Leffingwell-Ream Company.

Sales and Advertising Management

A Treatise on Advertising and Selling Problems

In this work Central Control and Production Engineering are applied to sales and advertising conditions. It shows how scientific methods of analysis and classification are used in this field, how guess work is eliminated by testing all facts and methods for practical application. This part of the library is in 2 volumes of about 500 pages, profusely illustrated. By Chester A. Gauss, E. E., M. E., Advertising Counselor; Advertising Engineer of S. K. F. Industries Inc., formerly member of Wightman-Gauss Associates; Advertising Manager Crocker-Wheeler Company; and Lucius I. Wightman, M. E., E. E., Advertising Counselor; formerly Advertising Manager of Ingersoll-Rand Co.

American Technical Society

Drexel Ave. and 58th Street, Dept. B-207, Chicago, U. S. A.

INSPECTION COUPON

American Technical Society, Dept. B-207, Drexel Ave. and 58th St., Chicago

You may send for my 7-day free inspection the BUSINESS MANAGEMENT LIBRARY. After a careful examination, if I decide to keep this 8-volume work, I will send you $2.80 and $3.00 a month until $29.80 in all is paid. But if I do not wish to keep it, the understanding is that I may return it at your expense which will end the matter. (NOTE: U. S. Territories and Colonies $26.80, cash with order. All other countries $29.50, duty paid, cash with order.)

Name.....

Position.....

Firm.....

St. and No.....

City.....

State.....

BOOKS AND PERIODICALS

MUSIC AND SHEET MUSIC

MOTION PICTURE BUSINESS

REAL ESTATE—FARM LANDS

FOR INVENTORS

PATENT ATTORNEYS

Quick-Action Advertisements continued on page 12

You Can Get One of These Fascinating, Big-Paying Radio Positions!

Certified Radio-tricians are Radio Experts and are in Demand Everywhere—They are Earning Fine Salaries In This New and Wonderful Profession, Where Opportunities are Unlimited, and Success comes Quick

HAVE you ever dreamed of a position away from the ordinary routine of humdrum business? Have you ever thought of earning a salary in a fascinating profession where the work is easy, hours are short, jobs are plentiful, and opportunities great! Have you ever thought of following the romantic life of the sea? Have you ever felt the desire to see foreign countries?—distant and strange lands? Have you ever pictured the interesting life of a radio operator at a land station?—the strange calls he receives, the appeals, the "news" that comes to him through the skies from the far-off countries of the world? Have you ever thought of the unusual and influential people such as grand opera stars, actors, public speakers you would meet as a broadcasting operator?

The Chance of a Lifetime

That is what the great profession of Radio offers you. Not only is it fascinatingly interesting, but it opens up opportunities for you to do what you want to do, go where you want to go—and all the time earn a big salary.

Now is the time for you to start to earn this big money—now, while you can be one of the early ones in the game. Hundreds of big-paying positions are waiting for trained Certified Radio-tricians to fill them. Spare time study in your home now will quickly fit you for the job with the biggest opportunities—the job that is unlimited in scope and salary. And the secret of this is that men, hundreds of them, are needed for this new work that has flashed upon the world.

Radio Is Still In Its Infancy

Radio has swept over the world. Thousands of stations, broadcast, commercial, ships, are in operation today. Hundreds more are being erected. Factories are putting millions of dollars into radio equipment, and will need thousands of Certified Radio-tricians. And yet Radio is only in its infancy. We are only dreaming today of its wonders tomorrow.

Become a Certified Radio-trician©

Personal Instruction By Radio Experts

By a wonderful, new method devised by the National Radio Institute you can quickly and easily qualify for one of these splendid, big-pay Radio positions—in your spare time at home. Radio experts instruct you personally, take you through the whole science of Radio step by step until you qualify as a Certified Radio-trician. The National Radio Institute is America's first and largest Radio School.

It has trained over 10,000 students, more than all other schools combined. It has placed hundreds of its graduates in wonderful positions, where they are making more money today than they ever made before.

Ship Owners Radio Service Corporation
Boston, Mass.

Employment Bureau,
National Radio Institute,
Washington, D. C.

GENTLEMEN:—
The company for which I work maintains the equipment and supplies operators for 400 Shipping Board vessels. You can tell your students that we can use them as soon as they pass examination for a license; even a second grade one, as many of the ships only carry second grade men, but pay them $125 a month right off; and first grade operators on passenger vessels get $150, so the future of Radio is very bright.

Sincerely yours,
J. B. WEED,
(A graduate of N. R. I.)

The National Radio Institute is constantly receiving letters like this from big concerns in search of radio-trained men, offering big positions, splendid salaries and unlimited opportunities.

Write For Free Book

Here is at last a profession that is far more lucrative than that of any other technical or mechanical employment you can secure. It is one of the greatest—if not the greatest opportunities that has been offered to men of ambition in 50 years. Are you going to sit idly by, wondering what it is all about? Or will you *act now*—when the field is wide open with big-pay positions going begging, and when you can prepare yourself so easily.

Write at once for our big, free book. "How to Learn Radio at Home." Learn the amazing opportunities awaiting you in this great field. Learn how the National Radio Institute, America's first and largest Radio School, qualifies you in a remarkably short time to take your place in this fascinating profession! Mail the coupon, or write a letter NOW—*for your own sake*.

National Radio Institute

Dept. 1210
1345 Pennsylvania Avenue, N. W.
Washington, D. C.

NATIONAL RADIO INSTITUTE, Dept. 1210
1345 Pennsylvania Avenue, N. W.
Washington, D. C.

Send me your free book "How to Learn Radio at Home," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radio-trician so I can get one of these splendid positions, and how your free employment service helps me to secure the job I want.

Name.....Age.....

Street.....

City.....State.....

Become an Expert Draftsman and Raise Your Income

No need for any man to remain where advancement is slow and the pay small. Drafting opens the way to important positions and high salaries. Many draftsmen earn $60 to $150 a week and are in line for promotion to even higher places.

Big Jobs Ready—

Not enough really expert Draftsmen are available for the higher positions that are open—which means that opportunities are always waiting for the man who can qualify. Factories, architects, electrical plants, contractors, sheet metal works, engineering concerns are constantly on the search for proficient Draftsmen.

Train Under the Chicago "Tech" Experts

The Practical engineers at Chicago Technical College will give you training which will make you also an expert. They will teach you the methods they use in their own work—prepare you to step into a paying position. This at the College or by mail. Small fees. Easy terms.

Learn by Mail

FREE Lesson

Trial lesson is sent to show you how we instruct by mail. No cost to you. Just send coupon. Get the lesson, catalog, etc., also free outfit offer.

SEND Act—to-day. Put X in the coupon to show which course interests you—then mail it.

CHICAGO TECHNICAL COLLEGE
1031 Chicago "Tech" Bldg., Chicago, Ill.

Send Free information on subject marked X:

- ☐ Machine Drafting
- ☐ Electrical Drafting
- ☐ Architectural Drafting
- ☐ Structural Drafting
- ☐ Sheet Metal Drafting
- ☐ Topographic Drafting
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AGENTS—Sell patented cigar lighters and cigar-case moisteners. Big profits. Start making money at once. Write for circulars, cuts and sales plan. Drake Mfg. Co., Dept. P., Milwaukee, Wisconsin.

GET our plan for monogramming automobiles, trucks, hand luggage and all similar articles by transfer method; experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

MAN in each town to refinish chandeliers, brass beds, automobiles, by new method. $10 daily without capital or experience. Write Gunmetal Company, Avenue "F," Decatur, Illinois.

AGENTS make 500% profit handling auto monograms, new pictures, window letters, transfer flags, novelty signs. Catalog free. Hinton Co., Dept. 125, Star City, Indiana.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Company, Dept. 467, Amsterdam, New York.

AGENTS make 140% profit. Eradium (luminous) Crucifix shines in the dark. Sells for $2.00. Costs 84c Complete line religious articles, crucifixes, bulbs, switch plates, house numbers, match boxes. Novel! Ornamental! Useful! Every home a prospect. Big sales. Get free demonstration outfit. The Pioneer Corporation, 6307 Yale Avenue, Chicago, Illinois.

SALESMEN can make $5.00 a day selling our calendars, pencils, signs, advertising novelties, yardsticks, whistles, etc. Liberal terms. Sells entire year. Fine side line. Local and traveling agencies. Model Calendar Co., Dept. 309, South Bend, Indiana.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge $1.50; make $1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Company, Dept. 47, East Orange, New Jersey.

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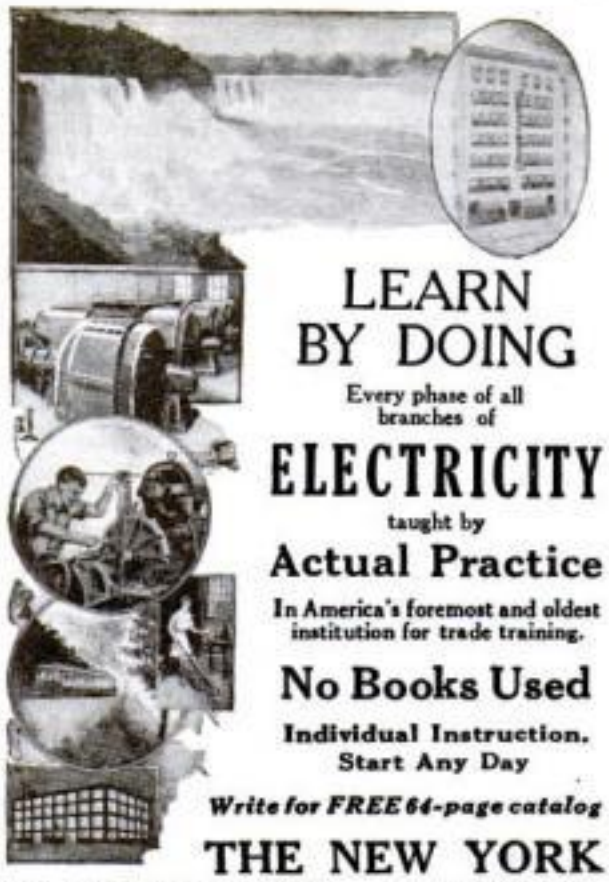

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Send me your amazing free book "Music Lessons in Your Own Home." This does not put me under any obligation.

Name .....

Address .....

Instrument .....

Quick-Action Advertisements continued on page 13

The New Sweeney Radio-Phone

Recognizing the demand for a set to receive the radiophone broadcasting of entertainment features as well as market reports and government information, our engineers have developed this receiver which incorporates simplicity of operation with its ability to receive long distance stations with clearness and sufficient volume to operate a loud speaking horn. The wave length range will cover those being used for the broadcasting of musical programs as well as the government live stock markets, grain quotations and weather forecasts. All sets are carefully constructed with the best quality of material and most careful workmanship. Each set is rigidly examined and tested before it is released. Radio frequency amplifications, one of the newest developments in radio reception, is used, which accounts for the extreme sensitivity of the instrument and enables the operator to pick up long distance stations. The audio frequency amplification increases the signal strength to such a volume that any type of loud speaking horn at present on the market may be operated. Write for special low introductory price.

Specifications Sweeney Radio-Phone

Cabinet: Genuine solid walnut, hand rubbed.

Circuits: Tuning circuit consists of an antenna inductance with four taps and a series variable condensers wave lengths from 175 to 550 meters. Two audio frequency amplifying tubes.

Panel: Bakelite 7x20¾. 3/16 inch thick *Control Knobs.* Smooth running and easily adjusted. Only two adjustments required in tuning.

Terminals are in rear of the cabinet to which the aerial ground, A battery and B battery are connected.

Wiring and connections substantially made with 1/16 inch brass rod with cambric tube sleeving.

SWEENEY BROADCASTING W. H. B.

This Is One of the Largest Inland Stations in the Country

and sends out official Government market and weather reports every day, besides giving musical, educational and religious programs on Sundays, Tuesdays and Thursdays. Through the courtesy of C. G. Conn & Co., Elkhart, Ind., Makers of Musical Instruments, we are broadcasting some of their concerts.

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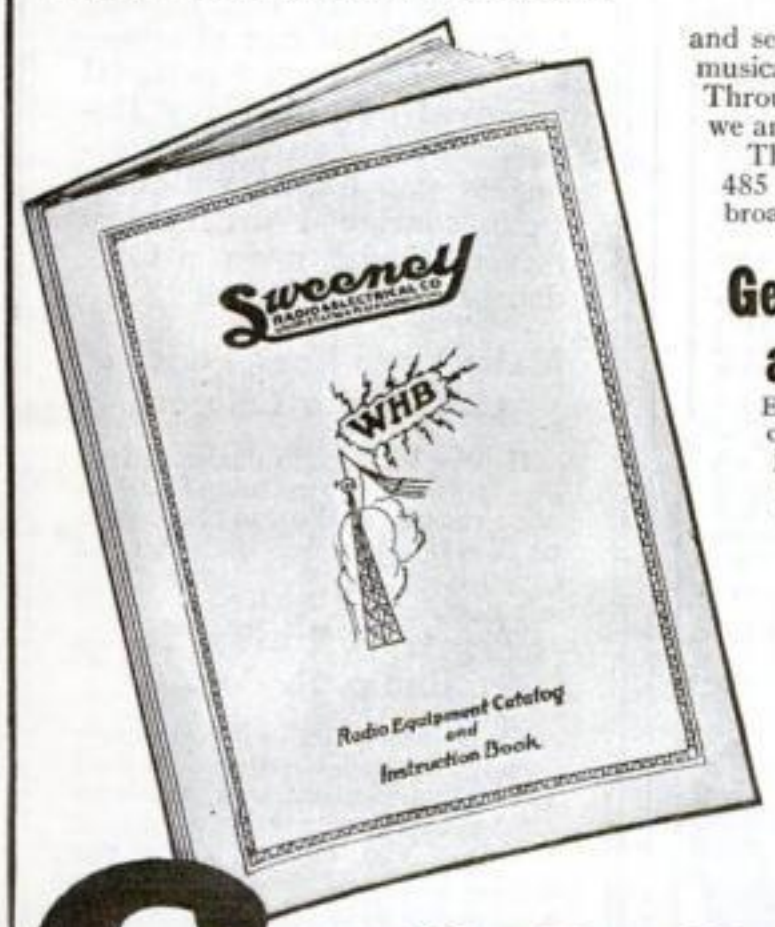

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Every radio enthusiast should have a copy of this valuable book which is just off the press. Contains new and interesting matter and descriptions and hints that will save you time and money, including hookups showing connections of crystal, regenerative, and high frequency amplification apparatus and give you much better results. Do not buy any radio supplies until you have seen this book as we have gone into this business on a great scale and are prepared to supply you with the best and most efficient new material at lowest prices. This book has has been prepared by some of the best known electrical and radio engineers and practical instructors. *Sent on receipt of fifteen cents in stamps.* Get your copy today.

Sweeney

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AGENTS AND SALESMEN

Quick-Action Advertisements continued on page 16

Is Your English a Handicap? This Test Will Tell You

Thousands of people make little mistakes in their everyday English and don't know it. As the result of countless tests, Sherwin Cody found that the average person is only 61% efficient in the vital points of English. In a five-minute conversation, or in an average one-page letter five to fifty errors will appear. Make the test shown below, now. See where you stand on these 30 simple questions.

SHERWIN CODY

Make This Test Now

Correct answers shown in panel below

1. Would You Write—

Between you and I	or	Between you and ME
I HOPE it would come	or	I WISH it would come
WHO shall I call	or	WHOM shall I call
It's just AS I said	or	It's just LIKE I said
How MANY are there	or	How MUCH are there
I WOULD like to go	or	I SHOULD like to go
The FIRST TWO lessons	or	The TWO FIRST lessons
He sat AMONG the three	or	He sat BETWEEN the three
The wind blows COLD	or	The wind blows COLDLY
You will FIND ONLY one	or	You will ONLY FIND one

2. How Do You Say—

evening	EV-en-ing	or	EVE-ning
ascertain	AS-cer-tain	or	as-CER-tain
hospitable	HOS-pi-ta-ble	or	hos-PIT-able
abdomen	AB-do-men	or	ab-DO-men
mayoralty	MAY-or-al-ty	or	may-OR-al-ty
amenable	a-ME-na-ble	or	a-MEN-able
acclimate	AC-cli-mate	or	ac-CLI-mate
profound	PRO-found	or	pro-FOUND
beneficiary	ben-e-fi-shEE-ary	or	ben-e-fish-ary
culinary	CUL-i-na-ry	or	CU-li-na-ry

3. Do You Spell It

calendAr	or	calendEr	repEtition	or	repItition
recEIve	or	recIEve	sepArate	or	sepErate
reprEIve	or	reprIEve	aCoModate	or	aCCoModate
donkEYS	or	donkIES	traffiCing	or	traffiCKing
factorIES	or	factorYS	aCSeSible	or	aCCesSible

New Invention Improves Your English in 15 Minutes a Day

Mr. Cody has specialized in English for the past twenty years. His wonderful self-correcting device is simple, fascinating, time-saving and incomparably efficient. You can write the answers to 50 questions in 15 minutes, and correct your work in 5 minutes more. You waste no time in going over the things you already know. Your efforts are automatically concentrated on the *mistakes* you are in the habit of making, and through constantly being shown the *right* way, you soon acquire the *correct* habit in place of the *incorrect* habit. There is no tedious copying. There is no heart-breaking drudgery.

Answers

1
Between you and me
I wish it would come
Whom shall I call
It's just as I said
How many are there
I should like to go
The first two lessons
He sat among the three
The wind blows cold
You will find only one

2
EVE-ning
AS-cer-tain
HOS-pi-ta-ble
ab-DO-men
MAY-or-al-ty
a-ME-na-ble
ac-CLI-mate
pro-FOUND
ben-e-FISH-ary
CU-li-na-ry

3
calendar
receive
reprieve
donkeys
factories
repetition
separate
accommodate
trafficking
accessible

FREE Book on English

Every time you talk, every time you write, you show what you are. Your English reveals you as nothing else can. When you use the wrong word, when you mispronounce a word, when you misspell a word, when you punctuate incorrectly, when you use flat, ordinary words, you handicap yourself. Write for our new book "How to Speak and Write Masterly English." Merely mail the coupon, and it will be sent by return mail. Learn how Sherwin Cody's new invention makes command of language easy to gain in 15 minutes a day. Mail this coupon or a postal AT ONCE.

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500 TWO-COLOR Letterheads $2.65. Samples free "Adverpress," Station C-5, Milwaukee.

AGENTS:—Cost $5.00 your profit $89.50 transferring monograms on autos, trunks, bags, furniture, etc., no experience, no license. Write for free samples. Transfer Monogram Co., Inc., 10 Orchard St., Dept. 155 Newark, New Jersey.

RISK a postal and learn how to start profitable business without capital, or experience. $60 weekly easy. Silvering mirrors, refinishing tableware, reflectors, plating. Complete outfit furnished. International Laboratories, Dept. 27, 309 Fifth Avenue, New York City.

AGENTS wanted. Sell to every motorist, engineer, motorman. Chemical felt wind shield cleaner. Pocket size. One rub keeps shield clear as long as it rains. Also super auto and furniture polish. Sell to dealers and users. Big money makers. Agents are wiring in orders. Full details free. Universal-Victor Company, Desk A, 1460 East Jefferson, Detroit, Michigan.

TAILORING agents—Our virgin wool tailored to order suits and overcoats sell fast at $29.50. All fabrics, all styles the same price. Over 600 men now making $50 to $150 a week. You keep deposits. Quick service, protected territory. 6x9 swatch outfit free. Write Salesmanager, J. B. Simpson, Dept. 226, 831-843 W. Adams, Chicago.

HELP WANTED

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, 7505 St. Antoine, Detroit, Michigan.

BE a mirror expert, $3-$10 a day; spare time at home first; no capital; we train, start you making and silvering mirrors. French method. Free prospectus. W. F. Derr, Pres., 26 McKinley Street, Baldwin, New York.

MEN—Age 17 to 45. Experience unnecessary. Travel-make secret investigations, reports. Salaries, expense. American Foreign Detective Agency, 321, St. Louis.

SILVERING mirrors, French plate taught. Easy to learn, immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Missouri.

WRITE photoplays; $50 each. Experience unnecessary; details free to beginners. Producers' League, 194, St. Louis.

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, New York.

BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

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$150.00 weekly. Start automobile repainting, retrimming business, easily learnt, without experience or capital. Many positions now being advertised daily. Frederick De Wilde, Sheboygan, Wisconsin.

MEN—Make money in spare time mailing letters, unusual opportunity offered. Send stamped addressed reply envelope. H. Normande, 147 W. 23rd St., New York.

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MEN, Women, over 18, desiring Government positions, $1400 up, write immediately for full information. Chicago Civil Service College, B-70 Kesner Building, Chicago.

BIG money made silvering mirrors, plating tableware, headlights. Outfits furnished. F. Decie Laboratories, 1133 Broadway, New York.

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STOP daily grind. Start silvering mirrors, auto headlights, tableware, etc. Plans free. Clarence Sprinkle, Dept. 95, Marion, Indiana.

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USED correspondence courses sold, rented, and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

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GET into the specialty manufacturing business. Amazing profits. We will send you free book explaining our system. Write immediately. A wonderful opportunity awaits you. Thos. Steel, President, 622 Main, Richmond, Virginia.

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BE a detective. Excellent opportunity, good pay, travel. Write C. T. Ludwig, 424 Westover Bldg., Kansas City, Missouri.

$75.00 will start you in business sharpening safety razor blades. $5 to $10 a day made easily. Write for free booklet. P. S. American Sharpening Machine Company, Chicago.

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Employers are ready to say it, to give you credit for thinking ahead of your job. The world is too full of men who just *wait* and *wish* to be *pushed* into responsible positions.

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Quick-Action Advertisements continued on page 18

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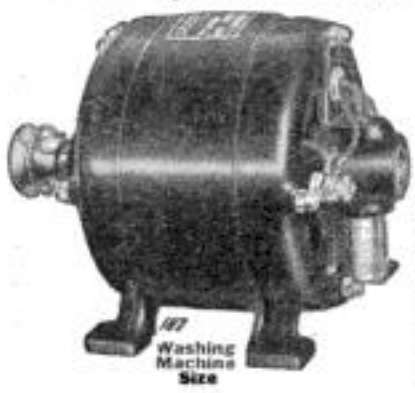

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GUARANTEED TO SATISFY

We absolutely guarantee these motors for one year. Free repairs or new motor if anything goes wrong within that time. Parts always obtainable. Rotation direction easily reversed. Attachment plug with 10 ft. cord 50c. Pulleys 1-1/2 inch or 2 inch, 50c.

Send cash or order C. O. D. by express.

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will do these things. It is scientifically constructed from strong, light-weight fabric. Easily adjusted and easily washed.

FREE TRIAL OFFER

Send your name, address and present waist measure. If no tape is handy cut a piece of string to the proper size and mail it to us. We will send you a "Wonder" Health Belt by return mail. At the end of five days if you are thoroughly delighted with the belt, remit $3.00 in *full* payment. If not, return the belt to us and you will not owe us a penny.

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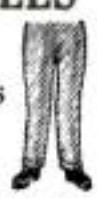

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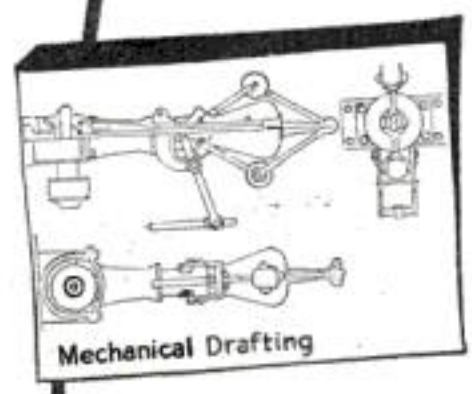

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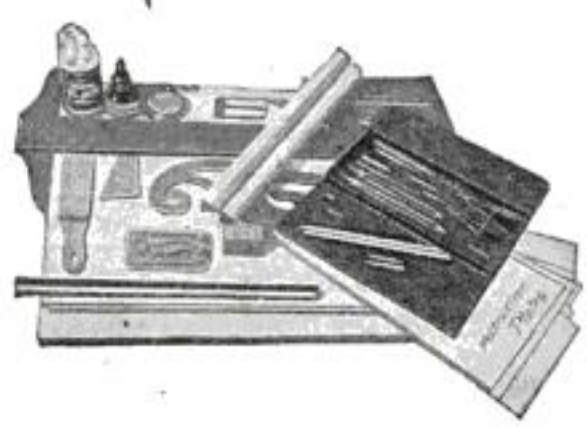

GOOD tools go a long way toward making a good draftsman. The set shown is of highest quality, and comprises the identical articles used by thousands of draftsmen holding top-notch positions. Consists of 16 pieces and 11-piece instrument set in plush-lined case. You get the COMPLETE OUTFIT FREE.

Make Drawings with This Set and Get $35 to $100 a Week

This FREE drawing set, together with the instruction we furnish will enable you to do expert drafting work—mechanical, architectural, map, radio, automobile, electrical, etc. We'll make a **real** draftsman of you. And we'll send this complete drawing outfit FREE with your first lesson.

You don't need artistic talent or "pull" to get a draftsman's job paying $35 to $100 a week. Our training has put thousands of men in these fine jobs. We teach **everything** you need. Never mind what work you've been doing all your life—we can fit you for these big, BETTER jobs.

Draftsmen Get Quick Promotions

Columbia graduates climb fast. We have hundreds of letters on file from graduates who have been promoted to Assistant Chief, Chief Draftsman, Production Manager, Engineer, etc. It is because the training we give is the **very best.** We promote **initiative** in our students, and that in turn promotes them to bigger jobs. The training we give is more complete than you'd get in many years' work in the ordinary Drafting Room. Our instruction covers **all** the phases of drafting, while the draftsman who tries to learn at "the school of experience" gets training along only one line.

Easy Money "On the Side"

A draftsman can make a lot of money "on the side." Many of our graduates make as much and more than their large salaries this way. There is always a lot of side-issue work to be had. Many graduates have built up businesses of their own this way. Wouldn't you like to see **your** name on the door of an office of your own as a Drafting Engineer or Consulting Draftsman? You CAN! We show you how.

Get the Right Training

"Training" is the whole secret of success as a draftsman. Columbia training is simple, sure, **complete,** PRACTICAL. Roy C. Claflin's method of practical mechanical drawing will make a Master Draftsman of you in a few months of home study. Mr. Claflin personally supervises your instruction—personally criticises and corrects your work. He makes the study pleasant and easy. You get plain, commonsense, brasstack instruction.

Columbia Draftsmen in Big Demand

The largest concerns in America, and the U. S. Government, employ Columbia draftsmen. We help you get a position. We have constant demand for our graduates. We keep employers advised as to your abilities, and thus help you get quick promotion.

SEND FOR THIS BOOK

Send the coupon **today** for illustrated book, "Your Future in Drafting." It tells all about the Columbia Course. SPECIAL OFFER FOR THOSE WHO SEND THE COUPON NOW. Do it.

COLUMBIA SCHOOL OF DRAFTING

Roy C. Claflin, Pres.,

Dept. 1788, 14th & T Sts., N. W., Washington, D. C.

SEND THIS COUPON NOW

Columbia School of Drafting,
Dept. 1788, 14th and T Streets, N. W.
Washington, D. C.

Without obligation to me, please enter my name to receive "The Compass," and send me your illustrated book, "Your Future in Drafting," telling me about your complete home study course and your help in securing me a position as draftsman.

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ENTER a new business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty; openings everywhere with all the trade you can attend to; easily learned by any one at home in a few weeks, at small expense; no further capital required; no goods to buy, job hunting, soliciting or agency. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

WE start in business, furnishing everything. Men and women, $30.00 to $100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime. Booklet free. H. Ragsdale Company, East Orange, New Jersey.

PATENTS procured—Trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Building, New York.

FORMULAS by experts, different, dependable. Interesting catalog free. C. Thaxly Company, Washington, D.C.

FORECAST your own market. Get our live new book "The Master Market Forecaster." It tells how. Fine opportunities await you. Market Forecaster Company, Box 174, Dept. C, Topeka, Kansas.

MAKE Money At Home making Toys—we show you how. Send 50c (no stamps) for complete working drawings and instructions. DeKalb Designing Co., Dept. 11, Decatur, Georgia.

JOIN National Institute of Inventors, 8 E. 14th Street. Strong protective membership society; will help secure, develop, manufacture and market patents. Dues $10 yearly. Booklet free.

OPTICAL GOODS

THE Ultra-lens high power microscope (patents pending) of reasonable price do the work of instruments of a dozen times their cost. Extremely interesting circular free. Specialty Mfg. Co., Milton, Pennsylvania.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

STAMPS AND COINS

CALIFORNIA gold $ ¼ size, 27c; $ ½ size 53c. White cent and catalogue, 10c. Norman Shultz, Colorado Springs, Colorado.

LIKE Triangular Stamps? To introduce our Sudden Service Approvals we'll send triangular Flume, set China ships, large $1.00 United States revenue, also packet 50 foreign, millimeter scale, perforation, gauge, ruler and bargain lists—for only 9c. Fennell Stamp Company, Department C, Fullerton Building, St. Louis, Missouri.

1000 American hinges and 100 different stamps, 25c. 50 French Colonies, 30c. 50 Portuguese Colonies, 35c. Lists free. Fine approvals. Elwood D. Weber, 812 South Avenue, Plainfield, New Jersey.

158 Genuine Foreign Stamps—Mexico War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only 10c. Finest approval sheets 50% to 60%. Agents wanted. Big 72-p. Lists free. We buy stamps. Established 29 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS, 20 unused. All different, 3 cents. Mention paper. Quaker Stamp Co., Toledo, Ohio.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., and Album 10c. 50 different U. S. 25c. 1,000 hinges, 10c. 1,000 mixed, 40c. List free. I buy stamps. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

UNUSED French Colonial stamps, 47 different, 20c. Nickles, 122 Florida Avenue, Washington, D. C.

OLD coins, large Fall selling catalogue of coins for sale free. Catalogue quoting prices paid for coins, ten cents. William Hesslein, 101A Tremont Street, Boston, Massachusetts.

119 DIFFERENT foreign 16c. 50 French colonies 26c. Radco, 68 Radcliffe, Boston 21, Massachusetts.

THREE Nyassa Giraffe stamps free to approval applicants. Wilmar Edgar, Cherokee, Iowa.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111C Nassau Street, New York City.

200 DIFFERENT stamps, 20c. Lists free. Michael, 5602 Prairie, Chicago.

BARGAIN packet stamps 10c. 300 good, mixed 30c, 500 superior assortment $1.00. Approvals. Harvey Teeple, S-19, Decatur, Indiana.

1000 DIFFERENT stamps, $2.80; 500, $1; 300, 45c; Frederick Onken, 630 79th Street, Brooklyn.

NEWFOUNDLAND Stamp Bargains! Lists sent. Rev. Butler, St. Georges, Newfoundland.

LARGE Copper Cent over hundred years old only 25 cents. Hundreds of other bargains. Fred Greenclay, Box 297, Alton, Illinois.

SUPERIOR "Cent" approvals. Lloyd, 25 Cottage Street, South Orange, New Jersey

111 DIFFERENT stamps, 11c. Approvals on request. Weld Stamp Co., New Bedford, Massachusetts.

TRY Gopher approvals. Priced net. Specify countries desired. Reference. Gopher Stamp Company, 3515 Third Avenue South, Minneapolis.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

Quick-Action Advertisements continued on page 20

MEN WANTED
write today to the SWEENEY SCHOOL

NOW I will guarantee a real job to qualified SWEENEY Graduates. Learn the Auto and Tractor business. Learn a trade. Eight weeks' course leads to employment. Free Railway Fare to Kansas City. Wonderful offer to you from World Famous Million-Dollar Trade School. FREE RADIO COURSE.

Young man, the only difference between a rut and the grave is that the grave is deeper. I say, get out of the rut. Do the work you like. Be independent. Learn a trade. Be a mechanic. Get into the auto business. You can earn big money. You can travel and see the world.

I have helped 50,000 men to success. This Million-Dollar trade school is the greatest success factory you ever saw. The way to learn is easy. You don't need any experience. I teach with tools not books. You learn your trade by actually doing the work.

You have a right to make a success of your life. Make a start now. I'd like to show you what thousands of men just in your position have done as a result of the Sweeney system of practical instruction. It's a shame for you to stick in a rut or work at jobs you don't really like.

Ask any Sweeney man. They are in good positions all over the country. Repairing and selling autos. Driving cars and trucks. Mechanics. Running garages, tire shops, battery shops. Welders. Handling radio supplies.

Learning is a real pleasure in the Sweeney School. World's finest equipment. Fine associates. Healthful surroundings. Entertainment after working hours. Instructors who take personal interest in you. Free radio course. Big radio broadcasting station. Call W. H. B.

I am now paying your Railroad fare to Kansas City and giving a free radio course. No extras. No books. You are sure of getting a job when you graduate. I can't tell it all here, but send for my big catalog. Investigate this real opportunity

FREE Simply send name today for my big 72-page catalog. Shows hundreds of pictures of men at work in the schools. Tells all about wages, profits, opportunities in auto and tractor business. Explains step by step how you learn. Interesting letters from graduates telling how they ma le good. Shows how men come from all over the world to this big school. Makes you wan't to join the crowd. Tells everything you want to know about, including all the new radio details. Includes contract for employment. No cost, no obligation. Clip the coupon or a postcard will do. Get the catalog now—that's the first step. Don't put it off one minute. No colored students accepted.

E. J. SWEENEY, President.

E. J. Sweeney, President. Dept. 1063 Sweeney Bldg., Kansas City, Mo.

Send me Free Catalog and Your Guaranteed Job Offer.

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Address.....

LEARN A TRADE
Sweeney
SCHOOL OF AUTO-TRACTOR-AVIATION
1063 SWEENEY BLDG. KANSAS CITY, MO.

World Wide Wireless

Today the Radio industry is surpassing all records in its rapid growth and development, yet those who are closely connected with the leading radio companies of the world say that this new art—*RADIO*—is yet in its infancy.

Think what wonderful opportunities there are for those who are qualified to enter this interesting scientific field. Why not identify yourself with a future that is as unlimited in its possibilities as is the mind of man.

Prepare yourself for a future in the Radio field through the **Home Study Course of the Radio Institute of America**—(the oldest and best equipped radio school in the United States)—over 6500 graduates, 95% of whom have secured well paying positions in this new branch of science.

The Home Study Course is prepared for those who cannot attend the Institute personally and exactly parallels the residence course. The same text books are used and the Institute staff of Instructors prepare and examine your home studies in a systematically organized course of instruction.

A THREE-WEEKS' POST-GRADUATE COURSE, IN OUR NEW YORK CITY INSTITUTE IS GIVEN FREE TO ALL STUDENTS OF THE HOME STUDY COURSE DESIRING IT.

The graduates of the Radio Institute enjoy a great and exclusive advantage in the close connection existing between the Institute and the Radio Corporation of America, the world's largest Radio Manufacturing and Commercial Radio Company.

Write for our booklet, **"Radio — the new field of Unlimited Opportunity."**

Radio Institute of America

328 Broadway (FORMERLY MARCONI INSTITUTE) **New York City**

Branch Residence School
New Call Building, New Montgomery Street, SAN FRANCISCO, CALIF.

AGENTS AND SALESMEN WANTED

57 MILES per gallon made with new patented gasoline vaporizer. Write for particulars. Vaporizer Company, Pukwana, South Dakota.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller; big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marui Company, Tribune Building, New York.

GET our Big Money proposition and Free Samples of easy applied Transfer Letters. Unlimited prospects. Auto Monogram Supply, 14 Green, Newark, New Jersey.

A BUSINESS of your own—Make sparkling glass name plates, numbers, checkerboards, medallions, signs; big illustrated book. Free. E. Palmer, 512 Wooster, Ohio.

SELL Minitmend for tires and tubes—cost 2c. Repaid: surpasses vulcanizing, saves 500% Every auto and accessory dealer buys. Profits amazing. Shaw made $21 first day. Hart $155 first week. Particulars and free sample. The Colonial Rubber Co., Dept. 88, Philadelphia, Pa.

SHIRT manufacturer wants agents; sell advertised brand men's shirts direct to wearer. No capital or experience required. Free samples. Madison Mills, 595 Broadway, New York.

WHY work for others? Make and sell your own goods. We show you how. Enormous profits. Write quick for free book explaining everything. Thos. Steel, President, 622 Main, Richmond, Virginia.

$1,080 made by Wingo in six weeks selling Never Fail Razor Sharpeners. Purdy made $40.00 first day. Other inexperienced men cleaning up big money. Applewhite, La., six orders in thirty minutes. Hurry—investigate—exclusive territory. Write to-day. Never Fail Co., 152 Allen Bldg., Toledo, Ohio.

MAKE $25 to $50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 24, Philadelphia, Pennsylvania.

AGENTS, $60 to $200 a week, free samples. Gold sign letters for store and office windows. Anyone can do it. Big demand. Liberal offer to general agents. Metallic Letter Co., 431 A, N. Clark Street, Chicago.

GREATEST sensation! Eleven-piece soap and toilet set, selling like blazes for $1.75 with $1.00 dressmaker's shears free to each customer; other unique plans. E. M. Davis Co., Dept. 59, Chicago.

$10 WORTH of finest toilet soaps, perfumes, toilet waters, spices, etc., absolutely free to agents on our refund plan. Lacassian Co., Dept. 615, St. Louis, Missouri.

ONLY one sale a day means $200 per month! Five sales $1,000 per month! Marvelous new adding machine. Retails $15.00. Work equals $350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. P, Grand Rapids, Michigan.

EARN $2.00 an hour in your spare time taking subscriptions for this magazine. Write to-day for the agency in your town. Popular Science Monthly, 225 West 39th Street, New York.

AMBITIOUS men, write today for attractive proposition, selling subscriptions to America's most popular automobile and sportsman's magazine. Quick sales. Big profits. Pleasant work. Digest Pub. Co., 1523 Butler Bldg., Cincinnati.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

AGENTS—$6 to $12 a day easy; 350 Light-weight, fast selling popular priced necessities; Food Flavors, Perfumes, Soaps, Toilet Preparations, etc. Agents Outfit Free; write today, quick, now. American Products Co., 7750 American Building, Cincinnati, Ohio.

SELL household necessities. Liberal credit extended. Hy-Gen-Ol Laboratory, Spring Valley, New York.

LOCAL distributors—For tire armor, an inside casing and armor that greatly increases mileage of all tires, prevents punctures and blowouts, saves tire repair expenses. Will give several thousand or more miles to almost all wornout tires. Outlasts several tires and costs less than good tubes. Very liberal discounts. Big opportunity in every locality. Write for exclusive agency. Motor Products Co., Lunt Avenue., Chicago.

SALESMEN—Dollars are waiting for you! Wherever internal combustion engines are used—and that means everywhere. Motor Ignition Amplifiers sell themselves on their merits by easy demonstration. More power to a new motor, new power to the old—verily they sell because they excel—they serve power and conserve ignition system, reduce carbon deposits and insure quick start with complete combustion. Salesmen, agents, dealers—investigate. Motor Ignition Corporation, Albany, New York.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared $800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

MAKE 600% profit. Free samples. Lowest priced gold window letters for stores, offices. Anybody can do it. Large demand. Exclusive territory. Big future. Side line. Acme Letter Company, 2800 N. Congress, Chicago.

$31.00 PROFIT with only $1.50 selling Pure Gold Leaf Monograms for Automobiles—trunks, bags—(Window and Wagon letters). Applied instantly. No experience necessary. No. 1 Outfit brings you $32.50—cost only $1.50—you make $31.00 profit. Get colored catalog. Full particulars. Free samples (36 designs). "Hurry." Nulife Auto-Aid, Hartford, Connecticut.

AGENTS: If you are making less than $300 a month, our proposition on Sentinel Burglar Alarms for windows and doors will interest you. Many agents earn $20 daily. Brand new inventions. No wires or batteries. Instantly attached to any door or window. No competition. Provides cheap burglar insurance. Big money makers. Write to-day for extremely liberal terms to agents. Sentinel Alarm Co., 1452 Marquette Bldg., Chicago, Illinois.

POLMET Polishing Cloth cleans all metals like magic. Sells fast at 25c. Sample free. F. C. Gale Co., 15 Edinboro Street, Boston, Massachusetts.

AGENTS wanted—To sell world's best Nifty Pocket pencil sharpener. Sample 25 cents. Fred Voigt, Mount Vernon Illinois.

AGENTS—$5 to $10 daily selling Snow Dust Washing Compound. Washes clothes without rubbing. Women wild about it. Big repeater. Free samples boost sales. Exclusive Territory. 300% Profit. Sample Free. Norman E. Conrad, Wabash, Indiana.

A practical system of constructive thinking that brings business and personal achievement.

The Secret -of- Mental Power

"Why do so many men never amount to anything? Because they don't think."
—Edison

MARK TWAIN once said that the average man didn't make much use of his head except for the purpose of keeping his necktie from slipping off.

And Prof. William James claimed that the average man uses only about a *tenth* part of his brain.

And Thomas Edison states emphatically that most men never amount to much because they don't *think*.

How about you? Are you using *your* head simply as a scarf-retainer? Are you using only 10% of *your* brain? Are you sitting, discouraged and discontented, at the foot of the ladder simply because you don't *think?*

It will pay you to find out.

Mind is the measure of every man. *Mental* power—not *physical* power—wins business battles and builds bank accounts.

The man with *brains* to sell fixes his own price, but the man who brings only *brawn* to market must be satisfied with the lowest wage that brute force brings.

In every age, in every clime and in every field of human endeavor the *trained thinker* wins where the *thoughtless toiler* fails.

Twain, James, Edison, Roosevelt, Rockefeller, Schwab, Carnegie, Woolworth, Wanamaker, Morgan, Hill, Harriman, Ford, Marconi, the Wright brothers and all other successful men reached their goals not because they knew how to use their *muscles* but because they knew how to use their *minds*. Does anybody doubt this? Isn't it admitted by all? Doesn't every one with "brains enough to grease a gimlet" *know* that it's true?

Only One Road to Success

Yes, indeed, there is only *one* road that leads to success and that is the *mental* road. If you expect to accomplish anything worth while by any other method than the *development* and *use* of your mental faculties, you are simply deceiving yourself. And the biggest fool in the world is the man who fools himself.

A recent magazine article states that intelligence tests in this country disclose the deplorable fact that 83% of the people are morons. You won't find the word "moron" in many dictionaries. It means a person with the mental development of a normal fourteen-year-old child.

Is it any wonder why so few people achieve any considerable success in life, when such an enormous percentage of them are so lacking in mental power? Such people have no more chance in competition with trained minds than a midget has to lick Jack Dempsey.

And isn't it simply absurd, when you stop to think about it, that most people are striving for success and yet they are doing absolutely nothing to strengthen and develop their *minds*, which is the *only* part of them with which they can ever hope to win success.

The principal reason that the trained *thinker* gets ahead is because he has so little competition.

The *unthinking* toiler works hard for small pay because almost anyone can do his work.

What are *you* doing—as the days go by—to develop *your* mind? Are you more efficient mentally than you were a month ago—or a year ago? If not, you are standing still. You haven't even started on the road that leads to *bigger* and *better* living.

Missing Success By a Hair's Breadth

The difference between *success* and *failure* is often but the breadth of a hair.

The man who is making *twice* as much as you are has nowhere near *twice* the intellectual ability. The man who enjoys an income of $10,000 a year is not *five* times the mental superior of the man who receives only $2,000.

Get this FREE BOOK

if you are interested in learning

How to think like an arrow.
How to compel attention.
How to master important problems.
How to overcome fear and worry.
How to "tune up" your mental motor.
How to develop new methods.
How to originate new ideas.
How to learn quickly and easily.
How to attract valuable friends.
How to have more time for play.
How to out-think the average man.
How to make your mind a mental mazda.
How to stop thinking in circles.

Thousands upon thousands of earnest, aspiring men are *almost* successful. But in this connection a miss is as bad as a mile.

With just a little more *mental* force—with a slightly better trained *mind*—with a little clearer knowledge of *right* thinking—hundreds of men who are now struggling along in the Poor-Pay Army—footsore and weary—would immediately find themselves equipped to command from *two* to *ten* times their present incomes.

Probably the man who makes $1,000 a month is only 10% to 20% better trained mentally than the man who is trying to make both ends meet on $100 a month. This is a *fact*. And it should be a most *encouraging* fact to every man who wants to *be somebody* and *get somewhere*.

The greatest thinkers the world has ever known have hardly more than scratched the surface of their latent mental powers.

Improve your mental power only 10% and you will *multiply* your earning capacity.

Get This New Book

We have just published a new book—*The Secret of Mental Power*. We will gladly send you a copy upon request, with our compliments and good wishes. And we want to state—as forcefully as we know how—that you will find it one of the most interesting and mind-spurring books you ever read.

If you had to quit work for a month in order to get and read this book, it would probably be one of the most profitable months you ever spent. But you don't have to do that. It takes but an *instant* to sign the coupon. You get the book for *nothing*. And you can read it in *twenty minutes*, as it is a small book of 32 pages and 16 illustrations.

Send for a copy of this book today. It tells about the most practical, common-sense system of constructive thinking—the easiest and quickest method of mind-building ever discovered — the secret of developing mental power in a way that is as fascinating as a game.

This book shows you the difference between *disconnected, irrational, faulty* thinking and *coordinated, normal, true* thinking.

It shows how you can tell by a man's appearance whether he is a *true* thinker or a *faulty* thinker.

It shows how a *wrong* thought produces a *wrong* action that brings a *wrong* result. And how a *right* thought brings a *right* action that can bring only a *right* result.

It shows the immediate and favorable result of *virile, constructive* thinking and the disastrous results of *flabby, impotent, haphazard* thinking.

In other words it gives you the solution of correct thought processes, which is the only secret of mental power.

Now Is the Time

Send for *The Secret of Mental Power* now. Do not delay. Do not put it off. Tomorrow you may forget all about it. And the loss will be yours, not ours. For although we have printed an edition of 20,000 copies, we do not expect to have a single one left at the end of thirty days. They are going—and going *fast*. Therefore act at once, for as Sophocles so truly said, "Heaven never helps the man who will not *act*."

Don't let the fact that you can get this book easily and at no cost deter you from sending for it or cause you to make the fatal mistake of undervaluing it.

There is, of course, no way of judging in advance how immensely valuable this little book may be to you. But by waking you up mentally—by showing you how to think straight—by showing you an interesting way to build mind power—it will convincingly prove to you that it is one of the most valuable messages that ever reached your mind, and that in taking advantage of this free offer you took a wise and positive step toward greater *mental* power, which is the *only* power that brings success.

Mail the coupon *now*. Or, send a postal if you prefer.

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Free-Book Coupon

Independent Corporation
Dept RM-7710, 22 W. 19th St., New York

Gentlemen—Please mail me at once—without expense or obligation of any kind—a copy of your free book, *The Secret of Mental Power*.

Name .....

Address .....

..... Pop.Sc. 10-22

"Thinkers act while sluggards sleep."

"True gold," said Confucius, "does not fear the fire" — and "Grebe Radio survives the most exacting tests."

Doctor Wu.

GREBE RADIO

MAKE your radio concerts a source of never-ending entertainment and delight for yourself and friends. Tiresome experiments and adjustments—unpleasant interruptions and noises are eliminated in the famous Grebe CR-5.

Correctly designed for thoroughly satisfactory service on all radio telephone work. Its range embraces all wave lengths from the amateur to the Arlington time signal.

A complete regenerative receiver in which but two simple tuning adjustments are used.

ASK your dealer to demonstrate—If he is unable to do so, send us his name for interesting circular.

A. H. GREBE & CO., Inc.,
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POPULAR SCIENCE MONTHLY
October, 1922

This Millionaire Makes Science a Hobby

H. L. Doherty, Traction Magnate with 150 Patents to His Credit, Is One of America's Greatest Inventors

By James H. Collins

WE WERE sitting in Henry L. Doherty's "back yard"—the strangest corner of a strange aerial home of one of the most interesting business men in the world. Perhaps you have heard of the unique skyscraper bungalow that this millionaire utilities magnate, inventor, and financier has built on top of a tall office building in lower New York. Perhaps you have read how, in his "electrified bedroom," with its magnificent view over New York harbor, the gray-haired genius of traction and gas spends many an evening reading in his "automotive bed," which, when he is ready to sleep, rolls smoothly out of the room, at the touch of a button and travels along its tracks to a skyscraper sleeping porch. Then its occupant presses other buttons on the control box beside him, the doors of the room automatically close behind him, the sun porch windows adjust themselves to his pleasure, and he is ready for a cool night's sleep under the stars.

Well, Henry L. Doherty's "back yard" is a palatial bit of "skyscraping veranda," just around the corner from this electrified open-air bedroom of his own devising. And there it was, surrounded by evidences of his interest in science—such as his radio set on its rubber-tired chassis—that Henry L. Doherty sprang this thought on me:

How Doherty Values Science

"If I were re-designing Henry Doherty's career, I'd make it 95 per cent scientific and technical, and five per cent administrative. Unhappily, the ratios have been just the other way."

He had been talking about mechanical hobbies, the recreational value to the man of affairs that comes from a keen interest in science, and the part that curiosity about "why the wheels go round" plays in building a man's success. And he had confessed to over 150 patents—many having basic value in the public utilities field—to say nothing of hundreds of other unpatented inventions made for his own amusement. Yet—according to this business man-inventor—science and mechanics had not played a big enough rôle in his life!

Many a hard-headed business man is inclined to patronize anybody who turns to scientific and mechanical recreations, or confesses to joy in inventing things. Yet here is an inventor as hard-headed a business man as any of them—a man who swings some of the biggest business affairs of the nation, whose companies in 200 communities serve over 4,000,000 Americans with gas, light, and electric power, and whose street railways transport 95,000,000 passengers a year—nearly as many as the entire population of the United States!

Henry L. Doherty, business man, inventor, and engineer, numbers among hundreds of unique inventions, this automotive bed which, at the touch of a button, rolls out onto his spacious and airy skyscraper sleeping porch

A Newspaper Lad's Achievement

Mr. Doherty's business career began at the age of 12, when he sold newspapers up and down the main street of Columbus, Ohio, where he was born May 15, 1870.

A short time later, he entered the employ of the Columbus Gas Company as an office boy, and through his indefatigable application advanced himself so that—having, by the way, only a primary school education to start with—at the age of 20 he had achieved recognition as a promising gas engineer.

It was not at all uncommon in his early career to find Doherty taking hold of rundown, inadequate plants and making them, within a short

period, produce more efficiently than they ever had before.

Mr. Doherty managed gas and other utility properties in all parts of the United States until, in 1910, he decided to branch out for himself. In that year, he formed in Delaware the Cities Service Company as a holding company to acquire securities of electric light and power, natural and artificial gas, steam heating, water, electric interurban railway and kindred corporations. The development of natural gas properties in the mid-continent fields brought an expansion of the activities of subsidiary companies, so that Cities Service Company has become, through its subsidiaries and associated corporations, one of the most important factors in the oil producing, transporting, refining and distributing industries of the United States.

"WHENEVER you see any human being doing any form of labor, remember that electricity will either do that labor, lessen the amount of that labor, or contribute to the comfort of the laborer."—*Henry L. Doherty.*

Electricity as Man's Servant

And all this time he was inventing. Right on the heels of some brilliant achievement such as a device for washing and cooling gas, comes an invention for personal comfort and convenience, such as the "automotive bed," which is but one "division" in a ningenious electrical control system that, at the push of a button or the turn of a knob, gives immediate service in any nook or any room in his aerial dwelling. Swinging at the head of his bed, for example, is a desk and book cabinet holding outside and house telephones and connections for supplying an electric fan and heating pad. Throughout the house are 64 of these convenience outlets and about the same number of plug receptacles for Mr. Doherty's telephone.

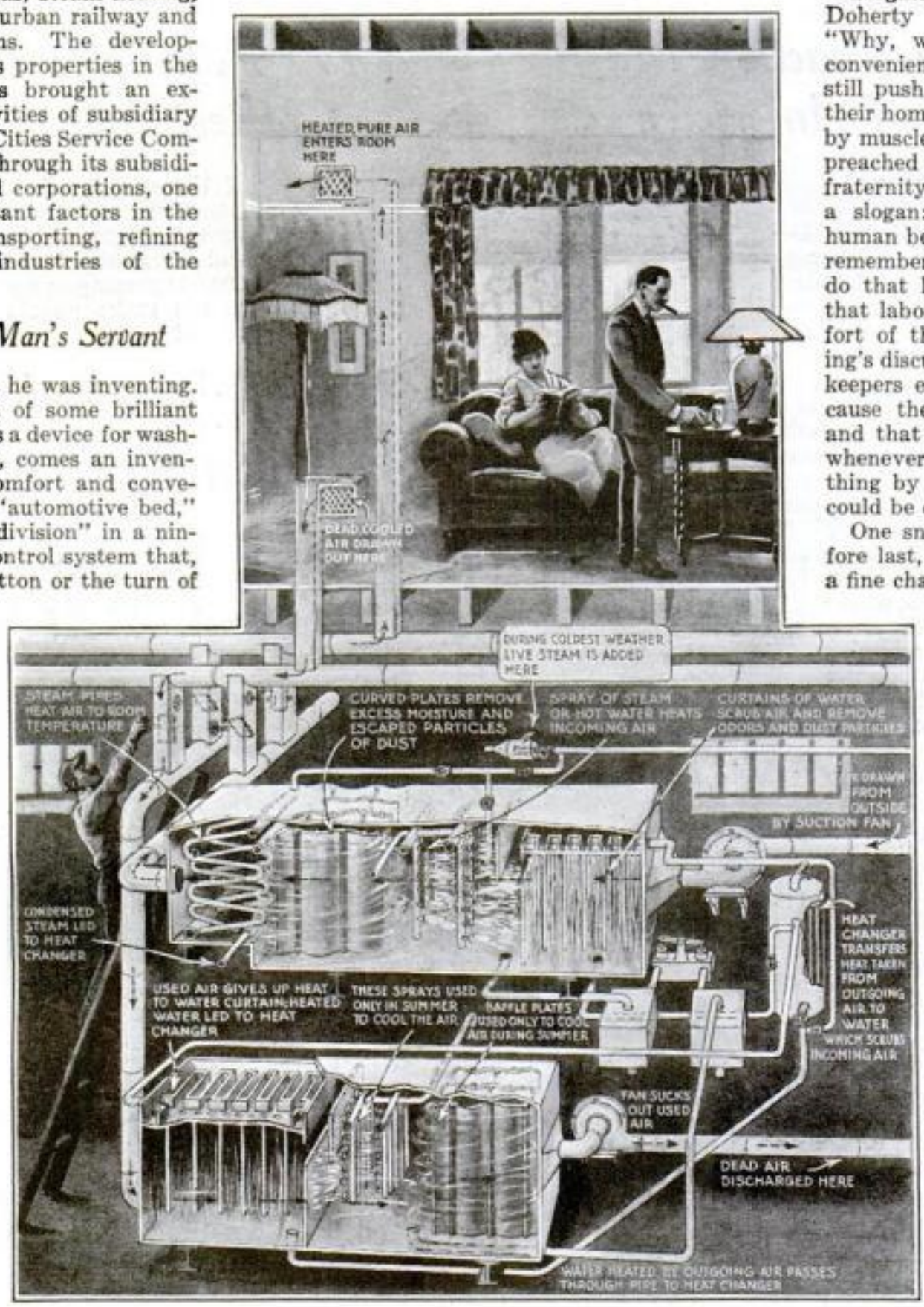
But of all the conveniences, the one that gives him the keenest enjoyment is his perambulating radio outfit. This two-stage set, mounted on a four-wheeled carriage, can be wheeled from room to room; for in each room is a plug connection with the radio aerial and ground.

"Were you fond of tinkering as a boy—taking things apart to see how they worked?" I asked him. "Did your mind run to mechanics and engineering?"

"I had a good bump of curiosity, but it was hardly mechanical," Mr. Doherty said. "Until the war, I thought I had an engineering faculty, but experience during those years led to stock-taking, and now I believe my bent is more scientific and analytical. I never took things apart to see how they worked. I was always more interested in the 'why' of a thing than its 'how.' My natural mechanical ability would be rated pretty near zero. In the laboratory, for instance, I was a bull in a china shop, breaking more glass than everybody else put together. I remember an old chemist of ours who dreaded my coming into his workshop. One morning he walked into the laboratory to find the open sky over his head. During the night, a windstorm had taken off the roof. 'Mr. Doherty has been here,' was his caustic comment."

One day, about 10 years ago, the writer was surprised by a telephone invitation to sit in a conference with Mr. Doherty. It was a gathering of electrical men. Mr. Doherty had been asking himself, "Why, with thousands of electrical conveniences right at hand, do women still push brooms and dusters around their homes, and mechanics drive tools by muscle power?" Mr. Doherty has preached this thought to the electrical fraternity until it has become almost a slogan: "Whenever you see any human being doing any form of labor, remember that electricity will either do that labor, lessen the amount of that labor, or contribute to the comfort of the laborer." After a morning's discussion, he decided that housekeepers endured drudgery simply because they didn't know any better, and that it was up to electrical men, whenever they found people doing a thing by hand, to show them how it could be done by electricity.

One snowy holiday, the winter before last, he stayed home, thinking it a fine chance to catch up with a lot of work. Looking down into the street where men were struggling to make a channel for traffic, his mind went to work on the snow problem. His habitual "why?" applied to all the pushing, shoveling, and hauling, suggested to him an entirely different way of dealing with snow—that of compressing it by machine into bricks and piling the bricks at whatever point on the street would least obstruct traffic, and letting them melt later and run off.



A Doherty Invention

TYPICAL of the mechanical ingenuity in 150 inventions that Henry L. Doherty has patented is the above complex apparatus, devised to maintain pure air, even temperature, and healthful humidity in houses, hotels, or offices. In summer the heat of the vitiated air is removed by water sprays and air cleansers. In winter the heat that would ordinarily be discharged with the outgoing air is reclaimed by transferring it to the incoming cold air, effecting a real saving in fuel.

Mr. Doherty confesses to scores of inventions made for his own amusement and never patented, while many of his patented devices are of basic importance in the public utility field

"Why?" the Keynote

"What sort of machine would you use?" I asked him.

"The machinery could be devised easily enough," he replied. "You have the principle already in brickmaking machines that squeeze out a continuous slab the length and height of a brick, and cut off individual bricks the right width faster than you can carry them away. Loose snow will compress to one tenth its density."

All this is characteristic of his mind and work—to find out why a certain thing is being done a certain way, decide that it can be done better, and then hand the details over to others.

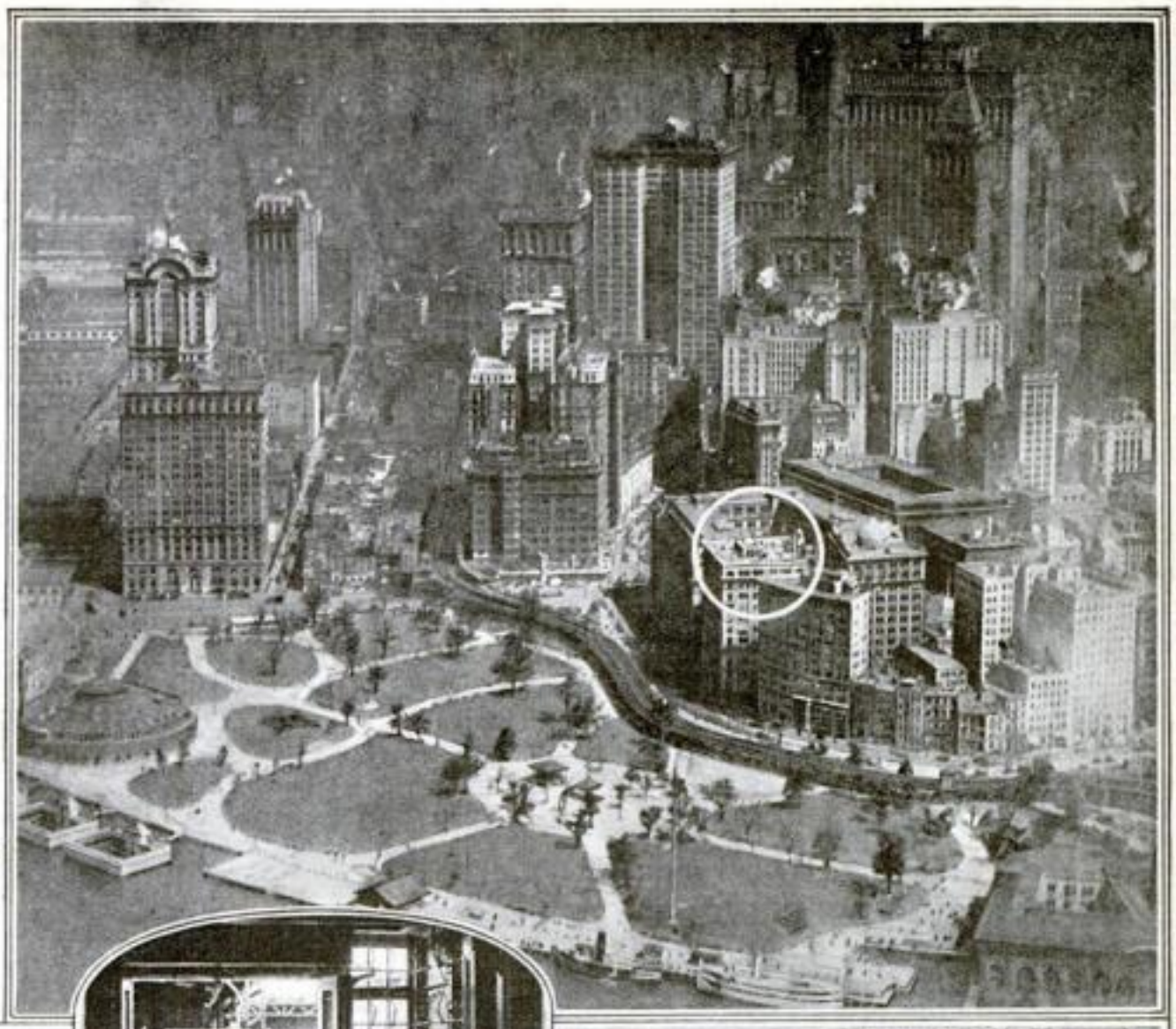
Doherty's apparatus for washing and cooling gas, though patented, has been widely infringed—testimony to its basic value. It was formerly customary to cool illuminating gas by passing its heat through a metal diaphragm to either air or water. Doherty's method is that of showering water through the gas, then passing this

water through a small cooler and back again as a spray in the gas. Heat will pass through a thin metal diaphragm from water to water nearly 100 times faster than from air to water.

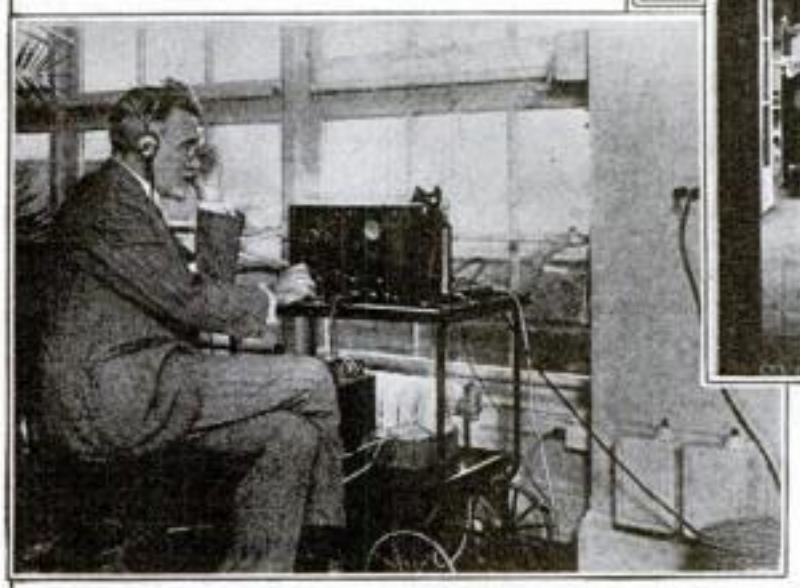
Other Important Inventions

His oil-spray for making water gas with the minimum amount of oil impinges two jets of oil exactly upon each other, vaporizing the oil in such minute particles that it is completely absorbed by the hot gas before it can reach the incandescent walls of the apparatus and be burned and lost.

One of Doherty's most important inventions is a clinkerless furnace. Hundreds of furnaces in the United States operate under Doherty patents. He has succeeded in burning any kind of fuel without the formation of any clinkers and yet has been able to get in his combustion chamber as high temperatures as any refractory material will withstand, also securing a very great economy in fuel.



Capping a tall building overlooking New York Harbor at the Battery is Mr. Doherty's "electric home," indicated by the circle at the right



Interior Views courtesy *Electrical Merchandising*

Mr. Doherty, listening to radio weather reports with his perambulating radio outfit, for which there are aerial plug connections in each room of his home at the "top of the world"

Certain buttons are pushed and, presto! —doors swing open and the auto bed rolls on tracks to the sleeping porch. If a storm arises, at the touch of a button the bed rolls its occupant back to shelter again

On the automobile-bed pictured above is the control box with its pushbuttons for operating the bed and adjusting doors and windows. Swinging on the bed post is a desk and book cabinet containing the telephones

His calorimeter for measuring the heat value of gas has eliminated cumbersome apparatus and gives exact measurements automatically. Formerly, the gas to be measured was carefully metered and then burned to heat water, and its B. t. u. was then calculated from the weight and temperature of the water. In Doherty's calorimeter neither the water nor the gas is measured, but the heated water in turn is used to displace a like quantity of gas from the displacement chamber, and from the exact relationship of volume between gas and water the calorific value of the gas can be immediately determined.

Mr. Doherty's inventive faculty seems to swing between highly technical problems, like those involved in his gas-making devices, and the improvement of cities.

"Have you specialized in city problems?" I asked him.

"No—or at least not until very recently. It is only because I have been supplying services to cities all my life that I look on them in this way. Take street transportation, for instance. It has been a terrific problem to meet the ever increasing demand. This is due largely to an inequitable system of charging. So long as we continue to charge a flat rate for a ride, no matter how long or how short it may be, we are continually encouraging long rides and discouraging short rides. When we charge according to distance, people will live nearer to their work or business. 'But that will increase congestion in our cities,' is the objection. On the contrary, it will decrease congestion, for our industries always tend to spread out into the outlying sections where land is cheaper, and employees will live in communities around them, a saner, healthier life for everybody.

Carfares Should Vary with Distance

"Already we have taught people to enter street cars at one end and leave at the other. If we were to put a speedometer on the car to measure the distance units, the passenger could withdraw a ticket on entering the car upon which would automatically be registered the point at which he got aboard, and we would then charge him a fixed amount to ride, the loading and unloading expense, plus a charge for each unit that he rides—and he would pay as he leaves the car."

"Pay-as-you-leave cars, eh?"

"That's the idea. When people can ride 25 miles for a nickel in New York City, they must rob the company on the long haul, and the company has to get even by robbing them on rides of a few blocks. They naturally blame each other for the fault of an outgrown, uneconomic system."

Just what is the secret in this successful financier's method of thinking, working and playing, that has given him such extraordinary ability to analyze a difficult situation, to quickly place his finger on a solution, and to point out how things may be done better than they are?

Mr. Doherty supplied the answer in an illuminating stock-taking of his life work.

"Looking back over the career of this chap Doherty," he observed reminiscently, "I'd like to re-design him on better lines. Science and inventions have been my recreation; but they should have been more. My first work, as a newsboy in Columbus, was the most interesting I ever had. In the gas industry I found a broader field and was absorbed in its chemical and engineering problems. But gradually, as I rose from position to position, the financial and administrative business took more and more of my time."

Is Einstein Wrong, After All?

How Theory of Relativity, Questioned in Recent American Experiments, Will Be Put to Test in Coming Eclipse

IS EINSTEIN'S theory of relativity about to be consigned to the scrap-heap?

Breaking upon an astonished public some three years ago, turning our conception of the universe topsy turvy, seeming to be completely accepted by scientists, it now appears possible that the theory of relativity may have to be considerably modified as a result of remarkable experiments with light rays carried out in California, on the top of Mount Wilson.

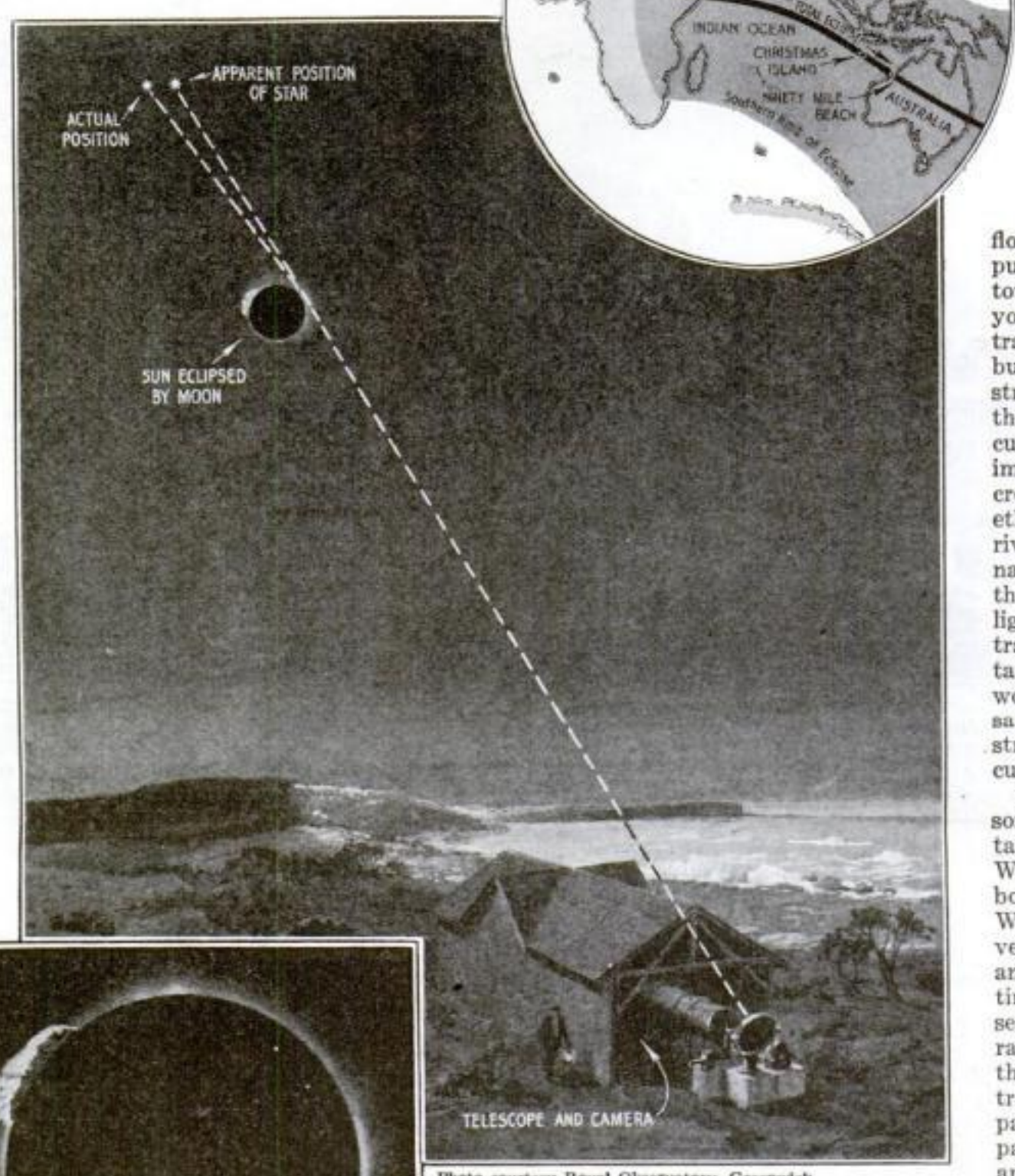
And while Einstein is being thus put to the test by American physicists here at home, another group of American scientists have undertaken a 16,000 - mile round trip to Australia, for the purpose of testing the Einstein theory by the light of the stars. When the total eclipse of September 21 sweeps over a lonely beach between sea and desert on the northwest coast of Australia, Dr. W. W. Campbell, of the Lick Observatory, will attempt to discover whether light from the stars is actually bent, as it passes by the sun, while other astronomers — British, Dutch and German — at remote points along the path of the eclipse will likewise try in a few brief moments to read in the heavens the truth or falsity of what is one of Einstein's chief premises.

It seems, then, that during the present month everybody will be watching with fascination the outcome of two different sets of experiments, undertaken just to determine the fate of the first theory in the realm of "pure science" known to cause universal popular excitement. Einstein himself has stated that there are probably only 12 men in the world who can understand his work, and yet from the very moment when it dawned on public consciousness, Einstein became a figure of worldwide fame. His name leaped to every tongue. When the great Swiss scientist came to this country he was fêted, mobbed, almost overwhelmed with attention and publicity. People realized that Einstein was a man who had brought a tremendously revolutionary thought into the world, and they were intensely interested.

For more than a century, science had assumed the existence of the ether as an all-pervading medium, in which light rays were transmitted by vibration. The theory seemed to explain light, and electromagnetic and radio phenomena as well. But no really conclusive evidence of the ether's actual existence had ever been sought until, back in 1887, Professor A. A. Michelson, of the Case School of Applied Science, Cleveland, devised a novel experiment. He reasoned that, since the earth moves through the ether at a rapid rate, it must have the effect of producing a "gale" of ether blowing all around us. And a light ray, he assumed, ought to take longer to travel against this gale of ether than with it.

Think of the experiment in terms of a rowboat on a swiftly flowing river. If you pull from one bank toward the other, your boat does not travel directly across, but a little downstream, according to the swiftness of the current. Now, if you imagine a ray of light crossing a stream of ether analogous to the river current, it is natural to assume that it will take the light a little longer to travel a given distance across than it would to travel the same distance downstream with the ether current.

Professor Michelson, with the assistance of Professor E. W. Morley, a neighboring scientist of Western Reserve University, constructed an apparatus for splitting a ray of light and sending one half the ray across a table in the direction of the travel of the earth, or parallel with the apparent ether drift, and the other half of the ray at right angles to the first, or straight across the ether drift. These rays were then reflected back to a telescope, where it was supposed the light waves composing the retarded half of the original ray would be "out of step" with those of the other. Instead of combining crest to crest, they would combine crest to valley, so that streaks of black would be seen where they neutralized each other. Such streaks are



At left, path of eclipse of September 21, with location of American observing party at Ninety-Mile Beach, and of Dutch - German party at Christmas Island

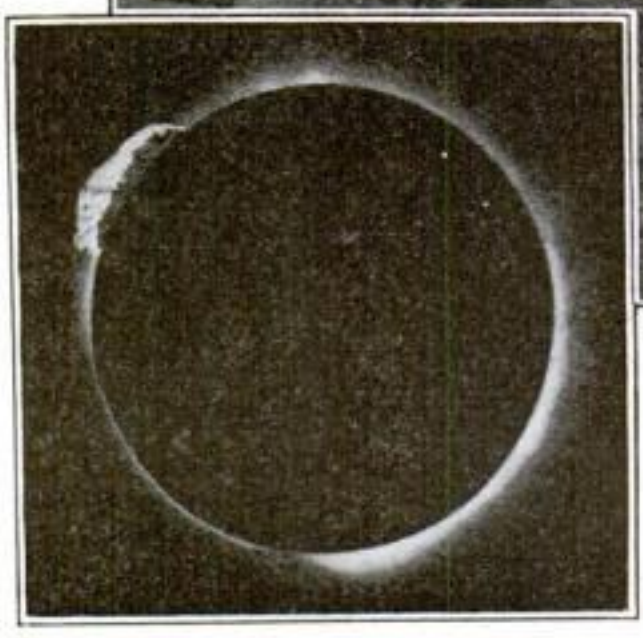
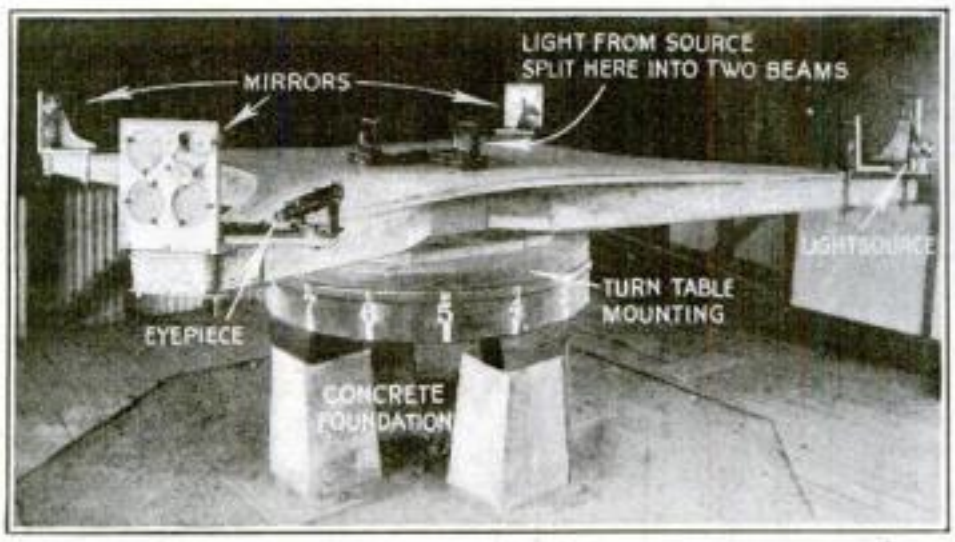


Photo courtesy Royal Observatory, Greenwich

HOW American astronomers will photograph the region around the sun during the eclipse of September 21. If their photographs do show star positions apparently displaced, as indicated above, it will be evidence that the star rays were bent by the sun's gravity. At left, "close-up" of a solar eclipse, showing sun's corona and vast prominence of incandescent gases

Dr. W. W. Campbell, chief of American astronomers, now in Australia to study the solar eclipse

THE nature of Professor Dayton C. Miller's light ray experiment to test the Einstein theory, as described in the accompanying article, is made clearer by the illustrations below. It consists, briefly, of sending a light ray across a table and splitting it into two separate rays that follow different pat s, one parallel to and the other across the supposed "drift" of the ether. In Doctor Miller's most recent experiments, the split rays, when recombined, showed in the telescope alternate fringes of black and white. This result, if confirmed, may indicate that one of the rays was delayed in passage, and the existence of an ether, denied by Einstein, may be assumed to account for this delay.



Albert Einstein, whose theory of relativity is again on trial before astronomers and physicists

called "interference bands," or "fringes," and the apparatus an "interferometer."

But in this now historic "Michelson-Morley experiment" of 1887, no interference fringes were seen. The two halves of the split ray seemed to return to the telescope in perfect step, with wave crest matching wave crest. The experiment "had negative results," but seemed to prove, if it proved anything, that there wasn't any ether—that light traveled through absolutely empty space, at a fixed speed.

Einstein promptly took this non-existence of the ether as one of his major premises. "If there isn't any ether, I shall create a theory that doesn't need it," he said. He came to the conclusion that light is transmitted, not by vibrations in an ether, but in the form of infinitely tiny "corpuscles" emitted from the light-giving body. These, being material, would be subject to the attraction of gravity. In other words, rays of light from the stars passing close to the sun should be bent inward by the sun's gravity. Here is where the famous astronomical experiment of 1919 came in. During the eclipse of that year, astronomers apparently definitely detected the bending of rays of light from the stars as they passed by the sun. It was this discovery — fulfilling almost exactly Einstein's predictions — that brought about the immense popular interest in the Einstein theory, although the theory itself was already 15 years old.

Meanwhile, in 1914, still sure that the trials of 1887 were right in principle, Professor Dayton C. Miller, world-famous physicist and head of the Department of Physics at the Case School of Applied Science, in Cleveland, repeated the Michelson-Morley experiment. It was believed the fact that the original apparatus was in a cellar below the level of the ground might have put it into a more or less "stagnant pool" of ether, or that, at any rate, the earth might be pulling the ether along as a fly swatter dragged through a bowl of water will propel some of the water with it. Therefore, Doctor Miller decided to perform his experiment on the top of a hill, and Euclid Heights, near Cleveland, was chosen as the site.

This time the experimenters were rewarded by the sight of very definite interference fringes in the telescope. The result was much smaller than expected, but it was still a definite result. For the first time in history, man seemed to see the earth move in relation to space, or absolute motionlessness. All other observed motion of the earth had been in relation to some other supposedly moving body.

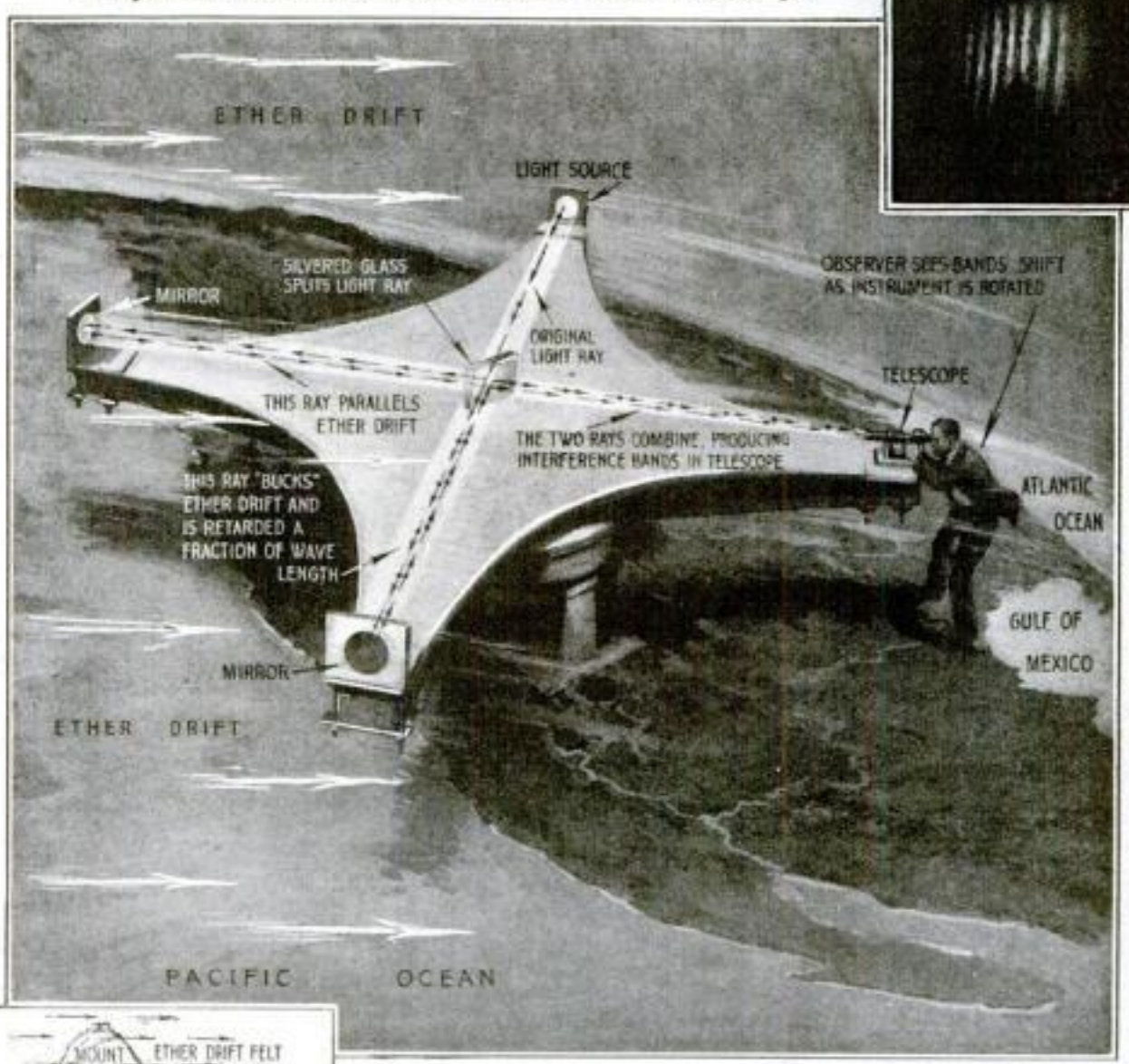
The effect, unfortunately, was not big enough to make the matter sure, and they had decided to repeat the experiment when war intervened.

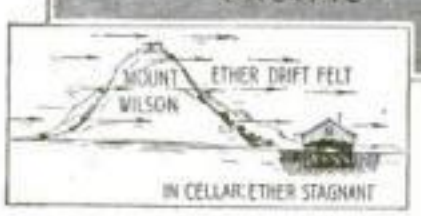
Meanwhile, the Einstein theory had gained its universal fame.

In 1921 Professor Miller decided to perform his 1914 experiment again, and this time to do it on the summit of Mount Wilson, Calif., in order to get as far as possible above the supposed "dragging" of the ether by the earth. He feared, also, some obscure magnetic disturbance arising from the steel framework of the original apparatus, and so made the new interferometer of concrete, with aluminum mountings. This instrument was set up on Mount Wilson, close to the building which houses the world's largest telescope, and was inclosed in a tiny shelter christened

(Continued on page 104)

Below, diagrammatic illustration of Professor Miller's apparatus, as set up on the peak of Mount Wilson. At right, the pointer and "interference bands" seen in telescope





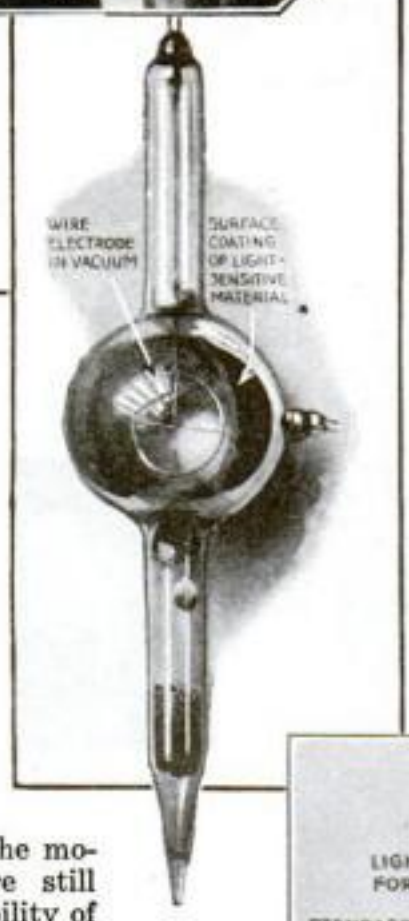
Sketch at left illustrates one suggested reason why no effect was obtained in a cellar in Cleveland, while atop Mount Wilson the experimenters got a definite result in attempts to prove existence of ether

Will America or England Win Race to Make Movies Talk?

Remarkable Cameras Photograph Actors' Words

THE greatest question in the motion picture world today is whether or not the pictures of players in the movies should be given voices and made to speak their parts like actors on the stage. While many artists, motion picture experts and writers assert that the power of the silent drama will be damaged if its silence is destroyed, scientists in three countries have lately made such remarkable progress in photographing and reproducing voices on movie films that it seems certain the coming of speaking photo plays—whether we want them or not—cannot be long delayed. The most promising recently invented methods of making the movies talk are described in this article.

Above, Prof. J. T. Tykociner, a scientist of the University of Illinois, and at right his sensitive photoelectric cell that recreates a voice image into sound



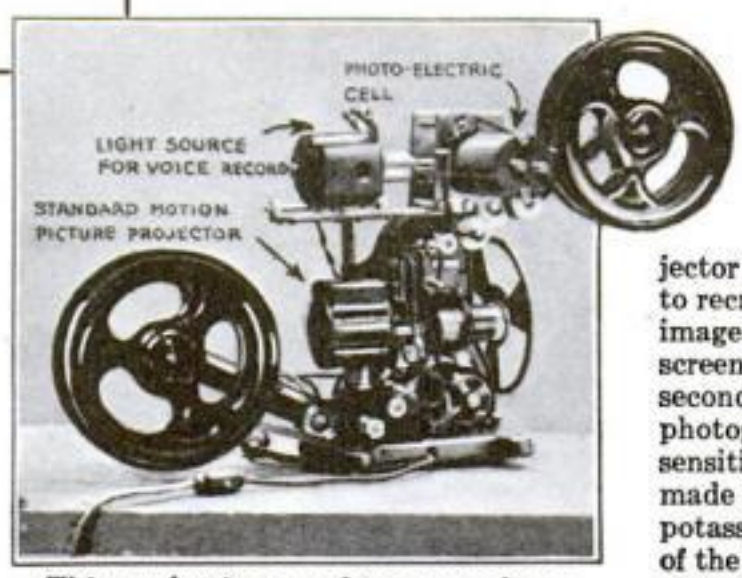
IS THE talking, singing movie soon to become more than a mere experiment? Will the speech and laughter of film heroes and heroines, now left to the imagination of audiences, soon echo through motion picture theaters with true realism, in exact accord with the movements and gesticulations of the actors' images on the screen?

While some experts in the motion picture industry are still arguing against the desirability of adding speech and song to silent pictures, a small army of scientists and inventors in practically every country of the globe are hard at work on ingenious schemes of adding more life to cinema films by giving the actors natural voices.

Picture and Voice on One Film

One of the most promising solutions, in so far as immediate results are concerned, comes from the University of Illinois, where tests of the talking pictures of Prof. Joseph Tykocinski Tykociner, assistant professor of research in the engineering experimental station, are reported to have met with marked success. His method of placing the image of a voice on the same celluloid movie film that carries the picture image, then reproducing the sound image into sound again, is not so revolutionary as are the refinements of the mechanisms by which he actually photographs the voice vibration by a beam of light, then conversely recreates by electricity the sound from the photographic image in amplified volume. Film samples produced by this method are reported not only to have produced the voice of the actor with a high degree of fidelity, but to have completely synchronized the voice and the action on the screen.

In the past, the difficulty of obtaining this complete synchronization of voice and action has been one of the greatest stumbling blocks in the way of successful talking movies. Attempts of the actor to talk into recording phonographs after performing before the cinema camera, watching a reproduction of his image to guide his speech, have resulted in only imperfect approximations of synchronisms.

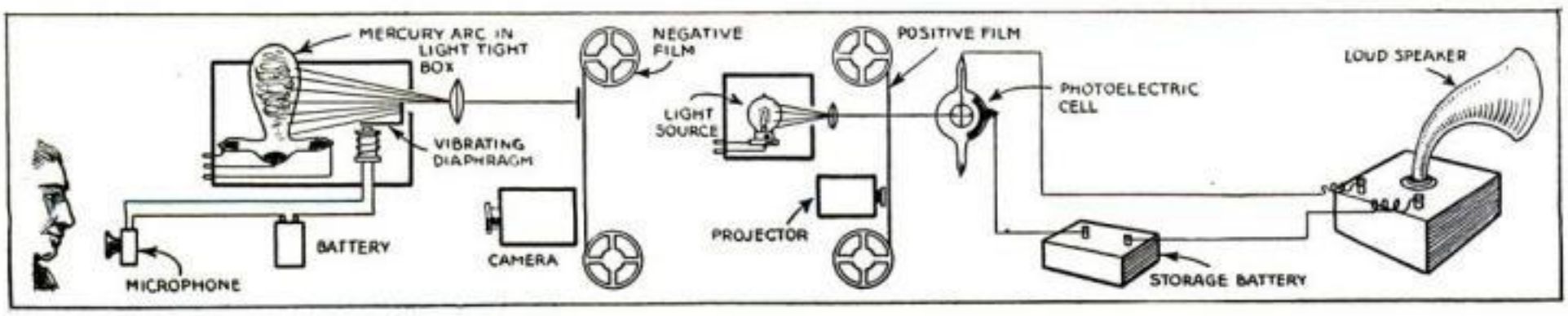


This projecting machine reproduces the voice record simultaneously with motion pictures, by a method made clear in diagram below, which shows recording and reproducing systems

Light Beam Records Sound

Professor Tykociner obtains his voice record by an attachment added to the ordinary cinema camera. This attachment comprises a powerful light source that throws a beam of light on to the film strip at the same time that a pictorial record is being made through the lenses. The intensity of this light beam is varied by a shutter operated by a diaphragm, which in turn moves in accordance with the flutterings of hidden microphones near the speaker-actor. As the intensity of the light beam varies, the sensitized film is likewise affected to a corresponding degree, and after development, this voice record appears as a narrow wavy band cross-marked by stripes of varying density.

After a positive is made from the negative, the positive can be run through any standard projector that is provided with an attachment to recreate the voice from the photographic image. The film picture is thrown on the screen in the customary manner, but a second ray of light focused through the photographic record of the voice strikes a sensitive photoelectric cell. This cell is made of a thin layer of caesium, rubidium, potassium or selenium deposited on one side of the glass wall of the gas filled bulb, and a plate or grid of wires suspended in the center. The deposited layer and the electrode are connected with a sensitive diaphragm through a battery. When



a beam of light strikes the light-sensitive metal film in the bulb, electrons that are set free travel in a stream to the electrode and allow a current to flow. Although the current that moves against this electron stream is small, of the order of one billionth of an ampere, the microphone is operated by amplifying the current flow by a series of vacuum tubes.

Since the current flow in the photo-electric cell will vary according to the variations in light intensity, the microphone will vibrate in strict agreement with the movements of the original microphone that stood before the speaker when the film was made.

By having the voice record on the same film and exactly opposite the action image, synchronization, the lack of which has so conspicuously impeded the advance of talking motion pictures, is at all times assured. If a section of the film is damaged by carelessness or by fire, the removal of the action removes the corresponding voice image, and although the gap will be evident to the audience, the action and voice from the faulty point on will be in full synchronism.

English Competitors

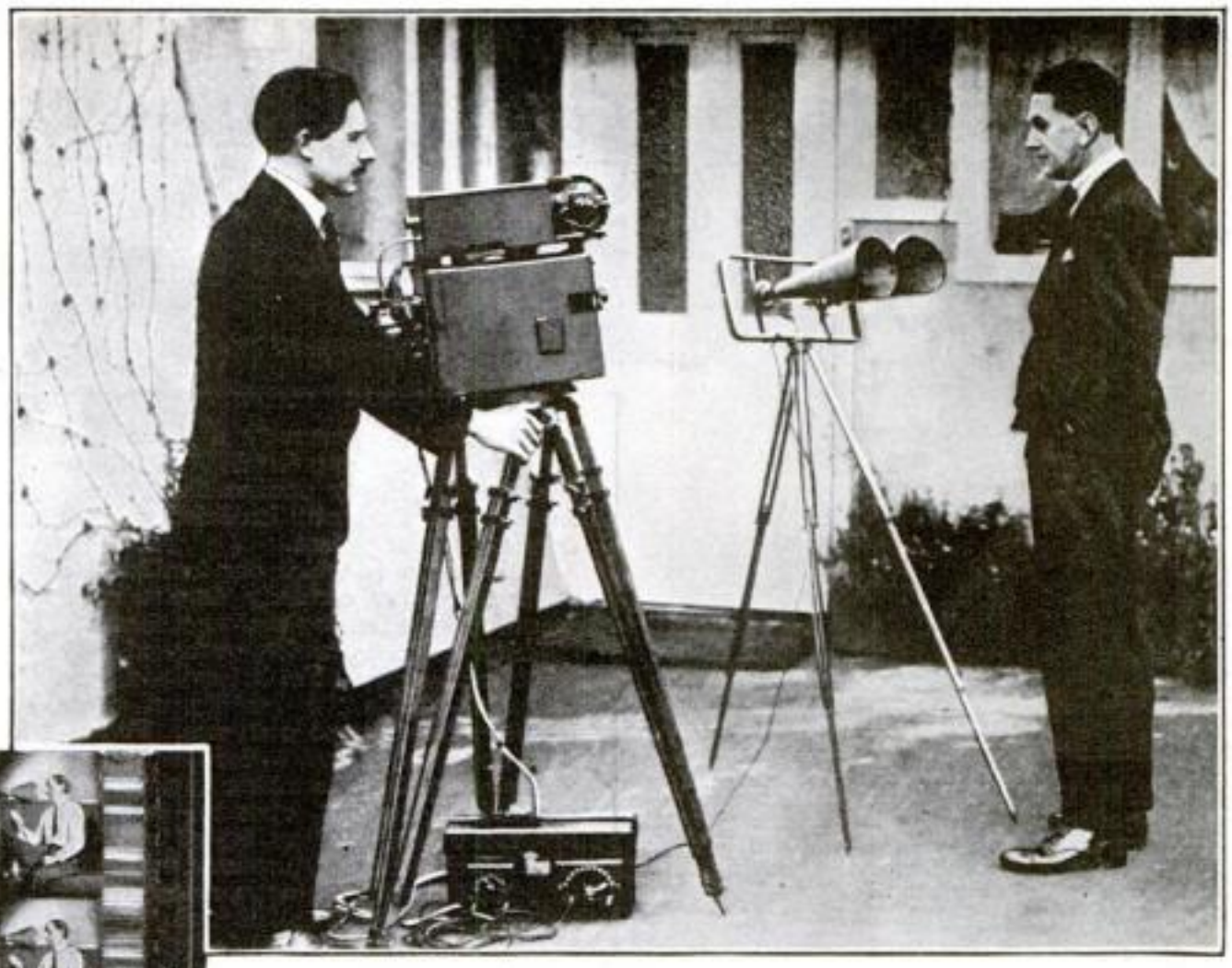
Another inventor—Professor A. O. Rankine, of England—working independently, has evolved a system of talking pictures following almost entirely the procedure of Professor Tykociner, except that Professor Rankine uses a light beam passing through a slit and a series of optical lenses to obtain the record of the voice on the film strip.

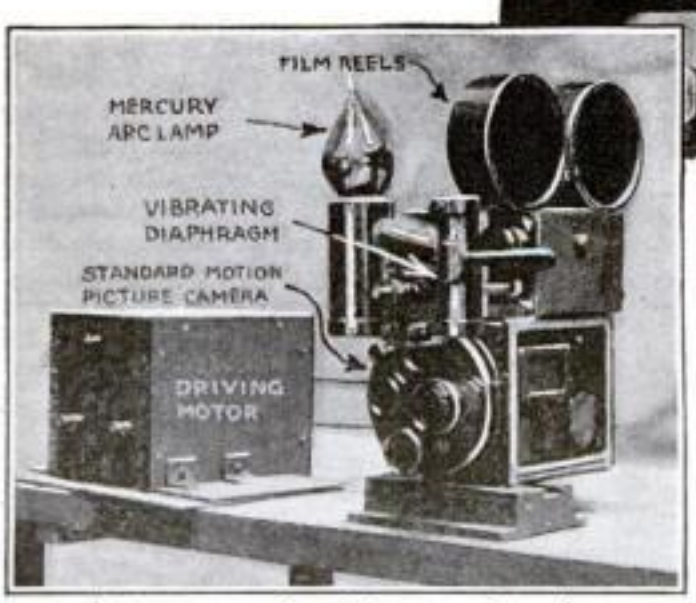
In England, also, Grindell Matthews has worked out a method of recording the voice of the cinema actor, in which a small mirror, oscillating in accord with the vibrations of the diaphragm of the microphone, prints its record on the celluloid film. Mr. Matthews uses separate recording devices for voice and picture, one above the other.

Two German inventors, Ernst Walter Ruehmer and H. Thirring, in a scheme for combining sound and action, photograph the sound waves by recording the fluctuations in the intensity of a ray of light under the influence of electromagnetic vibrations induced by the oscillations of a microphone diaphragm. These records are then reproduced at the same time and with the same speed as the picture images by utilizing one of the various forms of photo-electric cells.

The method of producing speaking movies by combining the phonograph and cinematograph—a method attempted by a number of experimenters with only partial success—is reported to have been developed to a high degree of perfection in France by Léon Gaumont. Heretofore the chief drawback to this method has been the extreme difficulty of keeping the two instruments "in step"—that is, of making the sounds from the phonograph keep pace with the action in the screen picture.

This difficulty Gaumont is said to have overcome successfully by means of improved synchronizing devices. These include a rheostat placed in a circuit common to the motors of both machines to secure equality of speed, and a small "booster" motor to remedy any lag or lead in the recording apparatus. For reproduction in the theater, an electric control automatically starts the cinematograph projection at a given sound from the phonograph. Two talking machines are worked alternately to secure continuity; when the record of one is exhausted, the other comes into play. By this means the sound records are joined up, just as films are cemented, end to end.





Above, a strip of talking motion picture film and Professor Tykociner's "talking movie" camera with which the film was made. Note, on the right edge of the film, the voice record consisting of light bands produced by variations in a light beam in accord with vibrations of a diaphragm.

Twin Camera Records Voice with Pictures

THIS is England's best bet in the race to develop a "talking movie" camera. Recently invented, by Grindell Matthews, the apparatus consists of two combined cameras, one of which records motion pictures, while the other makes a synchronous photographic record of the actor's voice. The voice is transmitted through two funnels to microphones and reproduced in the sound camera, above the picture camera, by means of a strong light reflected by a mirror oscillating in accord with vibrations of the microphone diaphragm and an interposed prism

Unique Talking Movie Device Invented by De Forest

WHILE an intensified current effort to produce commercially practicable talking movies is narrowing down to a contest between scientists in America, England, and France, the announcement comes that Dr. Lee De Forest, inventor of the audion used in radio receiving, is prepared to enter the race with a remarkable device of his own, called the "phonofilm," which is to be demonstrated in America sometime in the Autumn.

Mr. De Forest's invention corresponds to those described on this page, in that the sound waves of the movie actor's voice are reproduced in the form of vibrations on the film; but in other respects his apparatus is unique. Using standard motion picture camera and projector, he has a basic invention that he calls the "photion," a glass tube about 1½ inches long, which is fitted inside the camera, and which is said to develop under electrical stimulus a powerful violet light. The sound of a voice, picked up by sensitive microphones, is transmitted by high frequency current to the photion tube, whose violet light, modulated by the voice current, makes the sound wave that is photographed on the film.

How You Can Burn 30% Less Coal and Still Keep Warm This Winter

Use Scientists' Astonishing Discoveries about Your Heating Plant to Thwart Coming Coal Famine

By W. H. Driscoll
Director of the American Society of Heating Engineers

W. H. Driscoll, whose business is installing heating plants in skyscrapers like the Woolworth Building, and whose hobby is the heating of small homes

"THERE is apparently a grave fuel emergency approaching. I believe that it will sharply awaken the average American to the costly inefficiency of his domestic heating plant.

"The homes in which our families live 24 hours a day certainly deserve more attention from heating engineers than the office buildings in which we spend only eight hours a day. Yet homes have been neglected, while the heating of office buildings has become a science. Personally, however, I have derived more genuine pleasure from installing hygienic and economical heating systems in little bungalows than from my biggest jobs."

So speaks one of America's most distinguished heating engineers, among whose "biggest jobs" are installations in the two largest skyscrapers—the Woolworth and Equitable buildings of New York City—not to mention the Continental and Commercial Bank Building of Chicago, and the General Motors Building of Detroit. He is W. H. Driscoll, a director of the Society of Heating and Ventilating Engineers, and vice president of the Thompson-Starrett Co.

BECAUSE scientific heating of the small house is his hobby, Mr. Driscoll has consented to give readers of POPULAR SCIENCE MONTHLY in the accompanying article helpful advice for fuel economy.

His article is not intended as a scientific treatise. The figures given are in some cases simply approximations or estimates, for comparative purposes. Mr. Driscoll has merely endeavored to point out how much may be done to increase the efficiency of the domestic heating plant.

IF YOU could be assured that you could save a considerable part of your fuel bill for the coming winter by making a few simple changes in your heating plant and your house, would you try it? Accept, then, my assurance that the average householder can make such a saving; or, stating the case negatively, of the 260,000,000 or more tons of coal burned annually in this country for heating homes, at least 30 per cent is lost in preventable waste.

The best types of house heating plants have a thermal efficiency of about 60 per cent. That is, they deliver in heat to the rooms about 60 per cent of the fuel value of the coal burned in them. But most of the millions of stoves, furnaces, and boilers operated in private homes show a much lower efficiency, probably half as great. In some cases, the heat leaks into the cellar instead of being carried to the rooms upstairs. Sometimes the fault is in bad design of furnace, boiler, or chimney; more often it is in faulty installation. Sometimes the fault cannot be easily remedied, but there is hardly a house heating plant in existence that cannot be improved by any man possessing ingenuity and some mechanical skill.

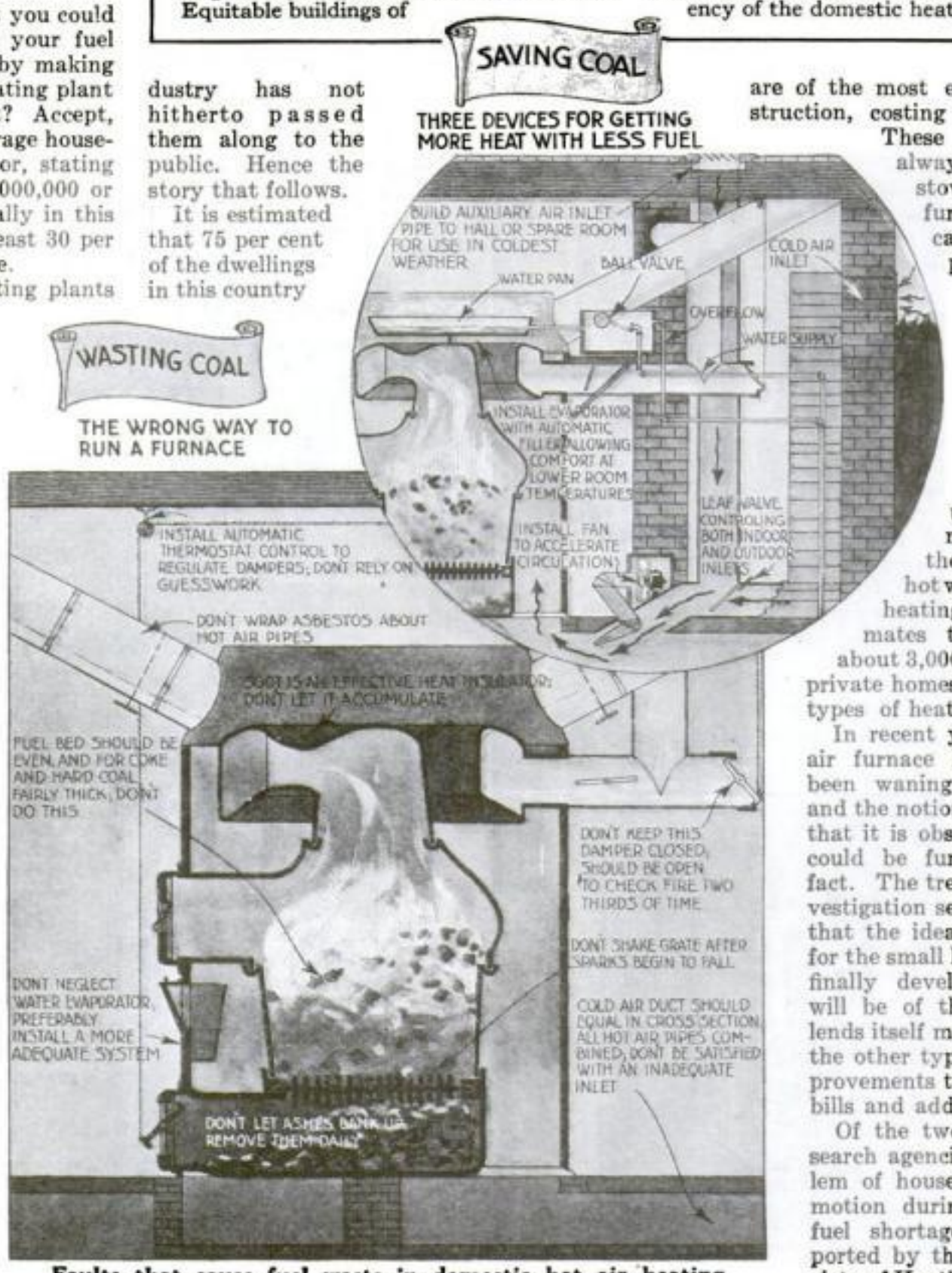
A Second Coal Famine

An industrial upheaval has made probable a fuel shortage this winter. Once before—during the war—we faced such a fuel situation, and that experience awakened as never before scientific interest in the problem of conserving fuel in the home. The conclusions drawn from a great deal of resultant research work are just becoming available to engineering, but in general the heating industry has not hitherto passed them along to the public. Hence the story that follows.

It is estimated that 75 per cent of the dwellings in this country are of the most economical construction, costing $6000 or less. These homes nearly always are heated by stoves or warm air furnaces simply because such heating plants are cheapest. There are some 10,000,000 homes in the country that depend on stoves for heat. And probably an equal number use warm air furnaces. An authority on steam, hot water, and vapor heating systems estimates that there are about 3,000,000 boilers in private homes used for these types of heating.

In recent years the warm air furnace has apparently been waning in popularity and the notion is wide-spread that it is obsolete. Nothing could be further from the fact. The trend of recent investigation seems to indicate that the ideal heating plant for the small home, when it is finally developed, probably will be of this type, for it lends itself more readily than the other type to simple improvements that will cut fuel bills and add to comfort.

Of the two important research agencies on the problem of house heating set in motion during the wartime fuel shortage, one is supported by the American Society of Heating and Ventilating Engineers in conjunction with the United States



Faults that cause fuel waste in domestic hot air heating plants—the commonest type—are made clear in this diagram. Inset shows inexpensive improvements that will make the system more efficient

Bureau of Mines at Pittsburgh. The second is conducted by the University of Illinois, with the support of the National Warm Air Heating and Ventilating Association.

The principal tests at the Illinois University laboratory have been conducted in a novel skeleton house, erected within the great mechanical engineering laboratories of the university. Various types of furnaces are installed under the skeleton house and the rooms are inclosed by various types of walls or partitions as desired.

Long Accepted Theories Exploded

One of the important results of these investigations has been to explode some of the theories held since time immemorial. For instance, one of the first things usually suggested to the man who seeks relief from a poor furnace, is to cover all exposed warm air ducts with asbestos paper. Common sense would seem to indicate that this is the right thing to do, but repeated tests have shown unmistakably that the usual single coating of asbestos paper actually increases the heat radiation from that pipe as much as one third!

This series of experiments indicates a general rule for insulation against heat or cold that the amateur heating engineer will find constantly useful. When insulating against low temperatures (warm air pipes, the heat or cold of outdoors, etc.), the best insulation is closed air spaces; but in insulating against high temperatures (furnace walls, steam pipes, etc.), use a solid insulator such as asbestos or magnesia.

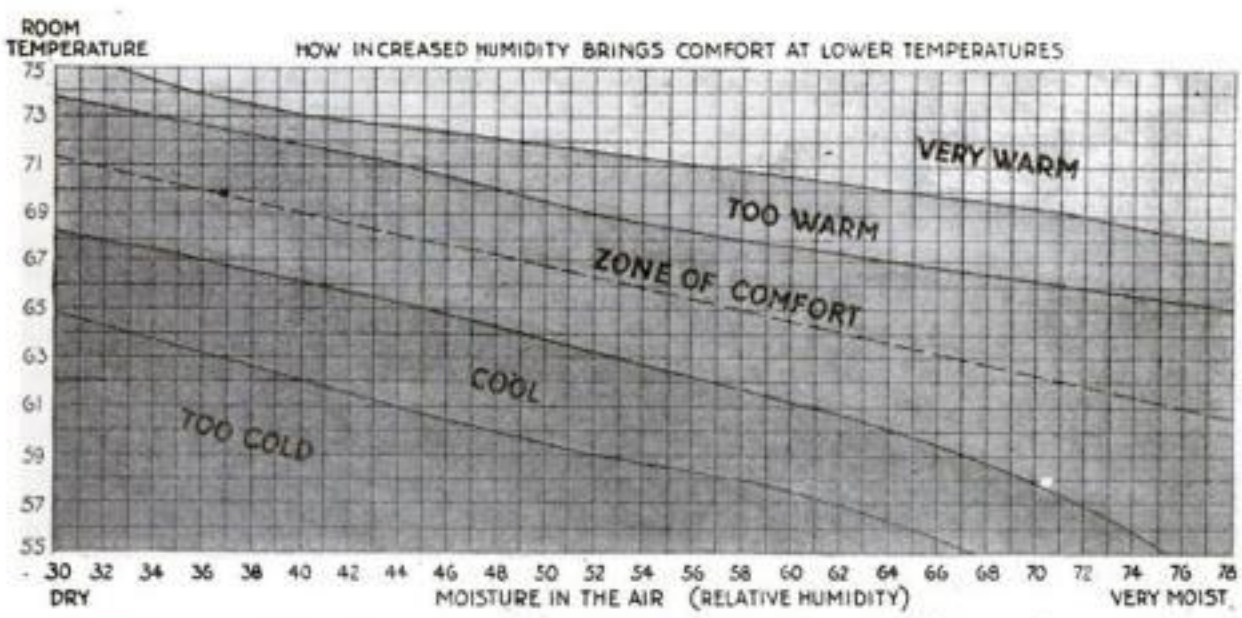
The proper insulation of a house against outside weather is too often neglected by the builder of small houses. It is hardly an exaggeration to state that fully 40 per cent of the heat losses in the average house can be attributed to this neglect—the leakage of air through walls and around windows and doors. But while the householder cannot very well tear down a wall to correct these defects, he can at least take the following precautions:

See to it that there are no holes at the top or bottom of the walls by which air can circulate from the cellar to the attic. If there are such holes, cover them with building paper or wallboard. It is a common thing to find that the insulation of a house has been applied effectively except to the ceilings of the top floor, where only one thickness of plaster separates a warm room from a cold attic. In this case, tack building paper over the tops of the rafters to inclose air spaces over the ceiling. Overhanging rooms, with no cellar beneath and only one thickness of boards on the floor, are often fatal to the operation of the heating plant.

Health in the Home

HEATING engineers are unanimous in the statement that two instruments—a thermometer and a hygrometer—are essential in every home. The hygrometer—for measuring relative humidity (one type shown at right) consists of two thermometers, one with a dry bulb, the other with bulb inclosed in a water-soaked wick. The difference in degrees registered by the two thermometers, when compared with an accompanying scale, indicates percentage of moisture in the air.

The picture above shows how the hygrometer should be installed near the floor when there are small children in the house. If a healthfully humid temperature were shown by an instrument placed far above a child's head, the temperature and relative humidity at about the height of the child would be too low



THIS chart shows how the temperature of the home may be lowered with no loss in comfort if the relative humidity of the air is increased, thus effecting an important saving in fuel. Extensive tests have demonstrated that perfect comfort is possible at a temperature of 63 degrees if the humidity is sufficiently maintained. Relative humidity can be measured by a hygrometer

Storm windows and doors (especially on the north and west sides of the house) and weather stripping will frequently save their cost in fuel in a single season and are among the ordinary precautions that ought to be taken.

The most reliable indication that a heating plant is wasting coal is a warm cellar. Sometimes the cause is defective construction of the furnace itself and there is little to be done about it, but more often the blame for a hot cellar lies in poor workmanship and careless installation.

The usual cause of a too-warm cellar from a warm air furnace is poor circulation of air within the furnace, which in turn may be due to two things—wrong layout of the warm air pipes overhead or, more likely, wrong construction of the cold air duct bringing air to the furnace.

Intake Pipe Causes Trouble

Nearly every furnace user has found it difficult to get an even distribution of warm air to the registers. Sometimes nearly all the heat will issue from one register, while other registers will be cold or may even draw in cold air. This condition is almost always due to the small size of the cold intake pipe, and if it is remedied, many of the common furnace troubles will be eliminated. The intake pipe ought to have an area in cross section practically equal to the combined area of all of the warm air pipes. It is safe to say that scarcely one furnace installation in a thousand meets this condition.

First aid for most furnace troubles consists in enlarging the cold air duct. In doing this, we ought to avoid the old, old mistake of taking all the cold air from outdoors. It is a mistaken idea that it is unhealthful to recirculate the air in the house. One investigator estimates that 90,000 cubic feet of air an hour is needed to heat the average house of eight rooms and bath. If 10 persons constantly occupied this building, their maximum requirement for fresh air would be 18,000 cubic feet an hour. As a matter of fact, the infiltration of air about windows and doors would bring in about that quantity of fresh air and it is simply a waste of fuel to heat the total quantity of air passing through the furnace from the outside temperature, instead of reheating the already warmed air in the rooms.

In a church where two furnaces were used, one taking its fresh air from the outside and the other from inside the structure, it was found in careful tests that the second furnace gave exactly twice the heat of the first in cold weather on the same amount of fuel.

Outside or Inside Inlets

It is a good plan, when remodeling the air supply duct, to provide both outside and inside inlets with a leaf valve at the junction of the two pipes so that all or any part of the air supply may be taken either from outside or inside the house. The outside air supply can then be used in mild weather, or whenever wanted.

If the furnace works all right in mild weather, but fails in extremely cold weather, relief may be obtained by placing a small electric fan in the inlet duct to blow air to the furnace and thus cause a brisker circulation throughout the whole system. The fan would be used only in warming up the

"AIR need never be heated above 65 degrees for comfort. Anything above that point represents waste and extravagance. It simply runs up a big coal bill and opens various doors to the coming of the doctor. The onset of coughs in winter is almost a sure sign of extravagance."—*Dr. William Brady*, noted American authority on health in the home.

house in the morning or in extremely cold weather. It is a matter of record that an ordinary electric fan installed in this way will double or triple the capacity of the heating system.

When a fan or blower is used, however, all air must be taken from inside the house, that is, recirculated. The fan causes a much larger movement of air through the furnace and as a result the registers deliver a large volume of slightly heated air rather than a small volume of highly heated air (a desirable thing). If air is taken from outside, it might even chill the house rather than warm it.

Thermostatic Control

Another very great improvement in the ordinary furnace installation is the addition of one of the now familiar automatic thermostatic control systems for the dampers. This apparatus cannot be made at home very well, but a number of standard makes are available, some of which automatically open the drafts in the morning at a predetermined hour. In fact, such controls literally do everything but shovel on the coal and take out the ashes. The instruments range in price from about $30 to more than $100, but will soon save their cost in coal. They entirely eliminate such accidents as letting the fire get too low before the dampers are turned, or forgetting that the dampers are open until the house is too warm—both fuel wasting operations.

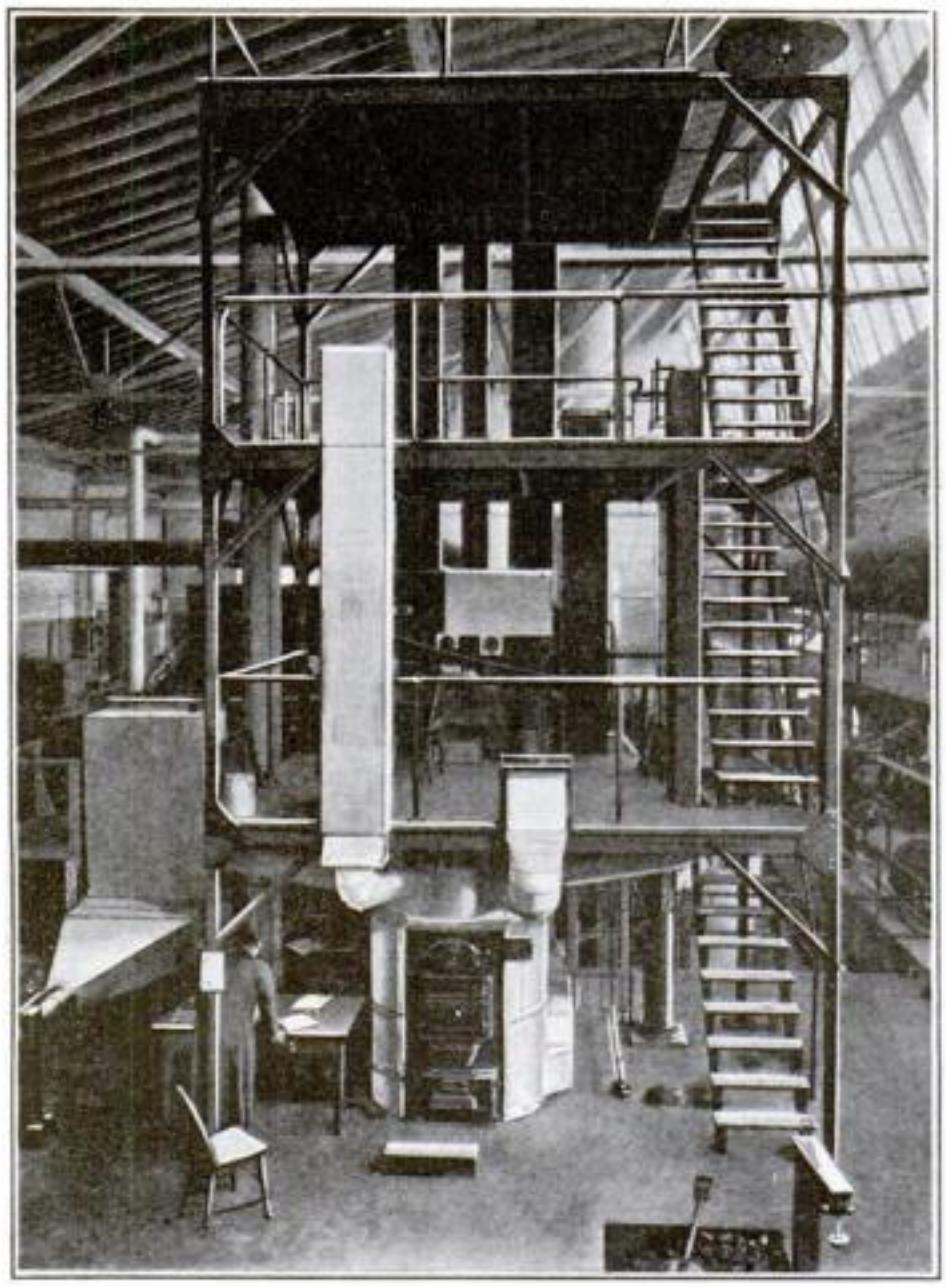
Steam, hot water, and vapor systems cannot be so easily improved by "home-made" methods as can warm air furnace systems, but there are a number of patent specialties that will materially increase their efficiency. Automatic control for the steam system is much simpler than for any of the others. A temperature regulator consisting of a diaphragm actuating a lever that is connected by rods or chains with the dampers will automatically maintain whatever steam pressure may be desired.

Economy of installation often influences the selection of cheap venting valves on the radiators. These soon become faulty in operation, with the result that sputtering, leaky valves or cold radiators are common experiences. Such conditions may be remedied by replacing these with higher grade and, in the end, more economical valves.

The hot water system apparently offers little opportunity for improvement aside from the possibility of improved control of the dampers. Contrary to the common notion, the hot water system does not improve the humidity conditions within the home. As a matter of fact, if the humidity conditions are to be improved, water pans or other separate method must be provided to introduce additional moisture.

The matter of humidity is of prime importance in domestic heating and it is the most thoroughly neglected of all the questions involved. The human body, like a house, is constantly losing heat, and most of the loss is due to evaporation of body moisture. When the air is humid, evaporation is slower, hence the loss of body heat is less than when the air is dry; and therefore we can be comfortable in the heated house at comparatively low temperatures if the air is sufficiently humid. Application of this principle reflects directly on the coal pile, for a saving of only a few degrees in heat means a large saving in fuel. Experiments with the classrooms at the University of Illinois, showed a saving of 17 per cent in fuel consumption in a temperature reduction from 75 degrees to 70 degrees. As a matter of fact, some health authorities urge a house temperature of 68 degrees, and it has been demonstrated in extensive tests that it is possible to be perfectly comfortable at 63 degrees if the humidity of the air is sufficiently maintained.

Humidity, it ought to be explained, is a relative term, and is expressed in percentage. Air absorbs water like a sponge, up to a certain point—the point of saturation—at which it will hold no more. When the humidity is 50 per cent, the air contains half of the total amount of water it can hold. This ability to hold water increases rapidly as temperature rises. For instance, at zero air is saturated when it contains one half grain of water a cubic foot. This same air heated to 70 degrees would have a humidity of only 6 per cent, whereas more than four grains of water a cubic foot at 70 degrees are necessary for bodily comfort.



Where Revolutionary Heating Facts Have Been Learned

MANY common but fuel wasting theories about house heating—such as the idea that it is unhealthful to reheat and recirculate the already warmed air in the home, or that a coating of asbestos paper will prevent heat radiation from warm air pipes—have been exploded by recent tests in this remarkable "skeleton house," erected in the great mechanical engineering laboratories of the University of Illinois. For the tests, various types of furnaces are installed beneath the "house," while the rooms are inclosed by different kinds of walls and partitions

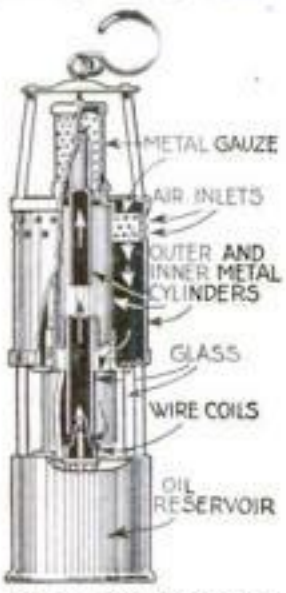
Home a Desert

It will surprise many people to learn that the average house in winter is actually dryer than the Sahara Desert. The average humidity of the great desert is about 30 per cent. During the month of February, 1919, the technical instructors of one of the high schools in Newark, N. J., kept account of the humidity within the classrooms and outside. The average outside temperature was 38 degrees and the average humidity 61 per cent. Heating this air to 70 degrees (there was no provision for humidifying the air within the building) reduced the humidity to an average of 15 per cent, just half that of the Sahara Desert. On some days the humidity in the classrooms was as low as 8 per cent, and only on two days did it reach as high a mark as the Sahara's average. Further investigations showed that this condition had a very bad effect on the comfort, ability for work, and the behavior of the pupils.

Investigations have conclusively demonstrated that the increase in sickness that always occurs in winter is due, not so much to a lack of ventilation, as to a lack of humidity in (Continued on page 102)

"Singing Lamps" to Warn Miners of Danger

SAFETY lamps that sing when danger from "firedamp" threatens have been devised for the use of miners. The principle employed is that of the "singing flame." Scientists have known for centuries that a hot flame burning in a narrow tube under certain conditions will set up vibrations and produce audible sounds.



How the lamp is designed

The lamp consists of a burner fitted with a small coil of wire and inclosed in a glass tube, which in turn is placed within a metal case. Air supporting the combustion enters near the top of the case, passes downward and then up by the burning wick. Adjustment of the flame will make it sing when the percentage of fire damp, or methane, reaches a dangerous proportion. In practice this has been found to be at two per cent.

When the percentage of fire damp reaches the danger point, the safety lamp "sings"

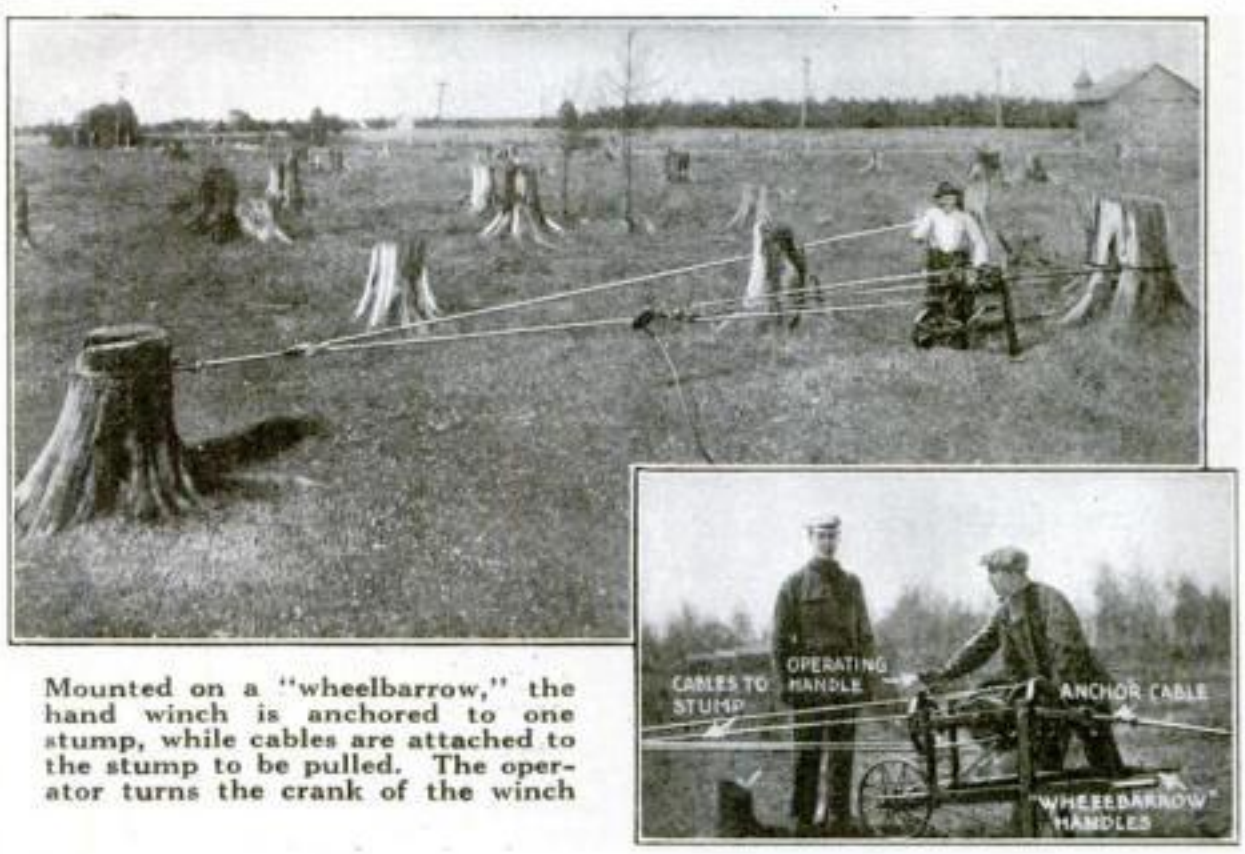
Signboard with Wings Revolves in Breeze

ANIMATED billboards operated by wind gusts have made a decided hit with merchants near Dayton, Ohio, the home of Mr. C. L. Correll, the inventor.

The sign is mounted on a structural steel tripod and has four wings, five by 10 feet in size, carrying advertising matter on both sides. All rotating parts are suspended from ball bearings to make the sign responsive to slight wind currents.

Four rotating wings, mounted on a tripod, carry advertisements

One Man Pulls Stump by Hand



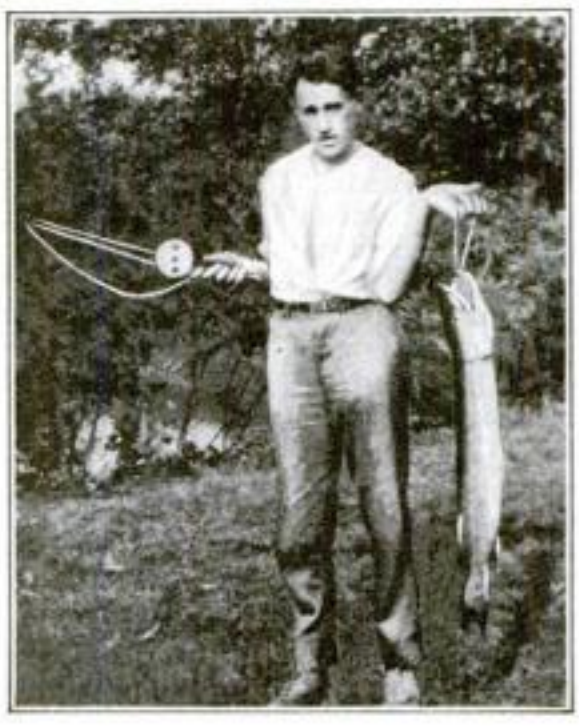
Mounted on a "wheelbarrow," the hand winch is anchored to one stump, while cables are attached to the stump to be pulled. The operator turns the crank of the winch

STUMPS can be pulled by hand with a light, portable machine recently invented by John Martinson, of Wrenshall, Minn.

By a very simple arrangement of gears, sheaves, and a double block and tackle, the strength of one operator is multiplied to that of 672 men. A wire cable slipped around the top of the stump yanks it out by the roots.

The essential part of the device is a light "wheelbarrow" carrying a hand winch operated by a crank. A strap is passed around the top of the stump to be removed, the tackle hooked on and set taut, and the portable winch anchored to another stump by a strap passed around the root. The operator then turns the handle of the winch until the first stump is hauled from the soil.

An adjustable gear ratio makes this machine adaptable to all sizes of trees. One farmer pulled 64 stumps in three hours, without assistance, in a contest at Deer River, Minn.



Two-Foot Fish Rod Casts Line 150 Feet

CASTS of 150 feet with a rod only 23 inches long are said to be common among fishermen who use a new rod and reel, recently developed in Dayton, Ohio.

The reel is made of aluminum with brass bearings. A counterbalance on the reel makes the line run freely, while a spring steel friction device permits the fisherman to adjust the tension.

The rubberoid handle, which is hollow, carries a rod setting pin. This pin, when pushed into the ground or stuck in the oarlock of a boat, supplies a support for the rod and reel for still fishing.

Scientist Asserts Will Power Can Be Weighed

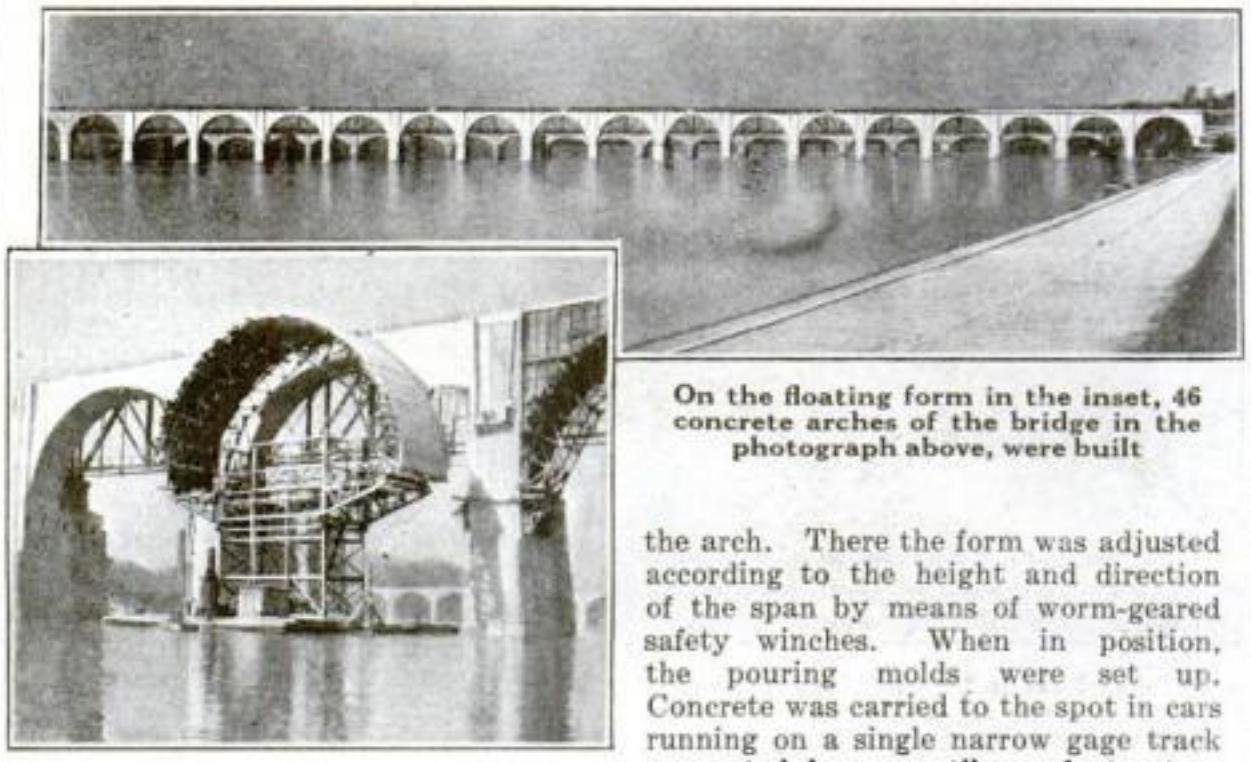
"POWER of will" is visibly demonstrated by a strange "will board," according to its owner, Mr. Hereward Carrington, of the American Psychical Institute and Laboratory.

The will board, originally devised by Dr. Sidney Altrutz, of Sweden, is a flat piece of wood pivoted unequally upon knife edges and connected at its longer end with a delicate spring scale by a flexible cord. When adjusted for the test, the weight of the board at the longer end is five ounces.

When any pressure is placed upon the short end, the scale reading will be less, of course. Yet when the subject is told to place the tips of his fingers lightly on this end and "will" that the longer end be depressed, the reading of the scale can sometimes be increased beyond the normal five ounces, it is said, thereby proving the subject's "power."

Depression of the long end of the board denotes strong will power

Bridge Arches Built with Floating Form



On the floating form in the inset, 46 concrete arches of the bridge in the photograph above, were built

BY USING a single, floating foundation form in the construction of 92 reinforced concrete arches for a new railroad bridge across the Susquehanna River at Harrisburg, Pa., the Philadelphia & Reading Railway recently solved the problem of supplanting an old 46-span steel bridge, placing the new bridge on the same piers, without interrupting traffic across the river.

The movable form for the concrete arches, with a span of 66 feet, had a width of only 13 feet nine inches, half the width of the completed bridge. It was supported by a steel traveler mounted on a barge, which was towed to the position for the construction of the arch. There the form was adjusted according to the height and direction of the span by means of worm-geared safety winches. When in position, the pouring molds were set up. Concrete was carried to the spot in cars running on a single narrow gage track supported by a cantilevered structure bolted to the upper part of the steel bridge. A derrick boat handled the molds and reinforcing steel.

In this manner, while one half of the new concrete bridge was being built, traffic was handled without interruption over the single track on the old structure.

As soon as the first half of the new bridge was completed, the one available track was shifted to it, while the other half was built.

Since there are 46 arches in the bridge, and each arch is made in two sections, it was necessary to set up the movable form 92 times in completing the bridge.

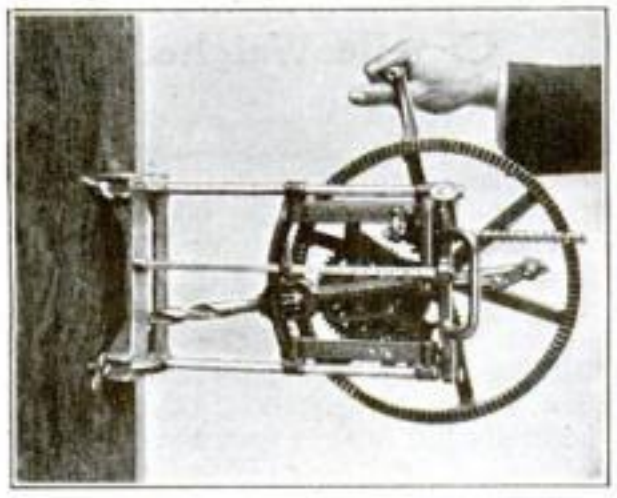
Disk Machine Cuts Turf Borders Evenly

A LAWN edging machine for cutting turf bordering on paths and driveways has been developed by a Cleveland manufacturer. The machine does the work formerly performed by a spade and guide line, but cuts more evenly.

The edger is driven by a single tractor wheel that runs along on the grass surface. This wheel, acting through gears, rotates small steel cutting disks at 3000 revolutions a minute. So high is the speed that the disks readily cut through twigs up to one quarter of an inch in diameter.

The disks are made self-sharpening by setting them at an angle.

Small cutting disks are rapidly rotated by a single tractor wheel



Mortising Machine Saves Carpenter's Time

A NEW portable mortising machine will cut any kind of a mortise in a few minutes, saving about 90 per cent of the time formerly required in this work. It is particularly designed for cutting door-lock mortises.

After the machine is clamped to the work, the rotation of the handle spins a revolving cutter back and forth and at the same time advances it as the slot deepens. The cutting tool is similar in form to an ordinary auger bit, but without the screw point.

The bottom of the tool is perfectly flat and its spiral edges, as well as the bottom edges, are sharpened. Various sizes of bits are supplied for different sizes of holes.

TAPE measures, rolled into bolts of German cloth, now tell salesmen at a glance the measure of cloth remaining in the bolt.

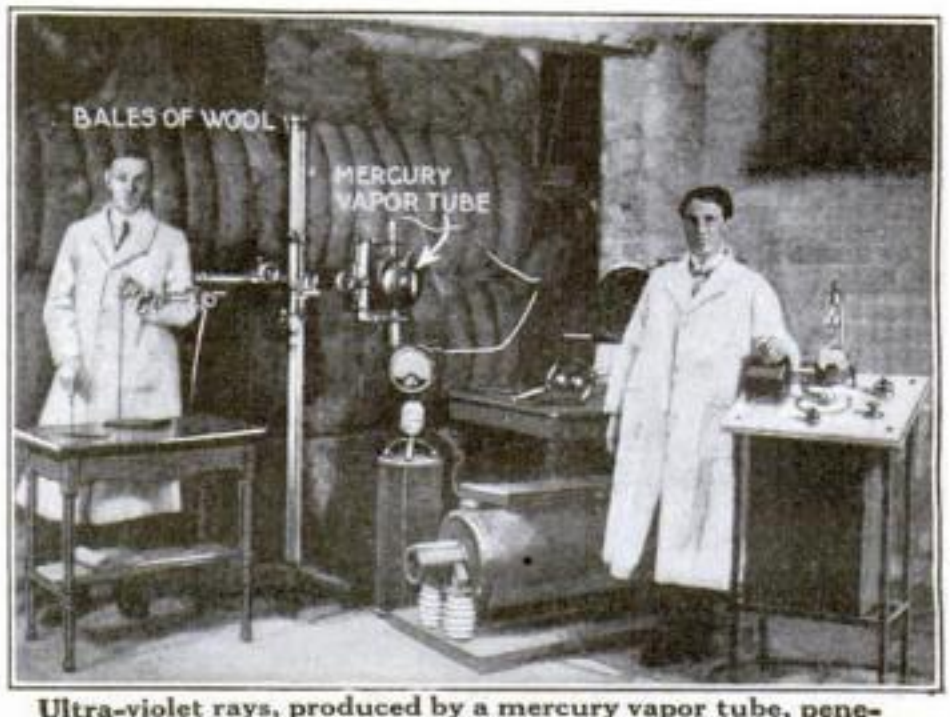
Ultra Violet Rays Kill Anthrax Germs

AN APPARATUS that makes possible the destruction of germs of anthrax and other dangerous diseases contained in bales of infected wool or hides, without opening the bales or separating their contents, has recently been perfected by Dr. Alfred Dinsley and Capt. A. O. Pulman, of London, England.

The economic importance of the invention is the fact that it will greatly reduce the cost of disinfecting imported wool or hides that heretofore has amounted to about three cents a pound. With this process, which instead of formaldehyde uses the germ destroying power of ultra violet light and certain invisible rays of even greater effectiveness, the cost is reduced to not more than half a cent a pound.

Most of the infected wool comes from East India and Persia, where anthrax is prevalent among cattle. The germs resist practically all methods of disinfection that do not, at the same time, cause a deterioration of the wool. Formaldehyde proved effective, but its employment made it necessary to unpack every bale, wash and scour the contents, and then repack the bale.

During the war, Doctor Dinsley experimented extensively with ultra violet and infra red rays, although not with the object of ascertaining their potential germ killing power. The remarkable penetration of the ultra violet rays suggested the possibility of employing these and other invisible rays for disinfecting. After several years of experimenting, Doctor Dinsley, assisted by Captain Pulman, evolved an apparatus in which ultra violet rays are produced by a mercury vapor tube.



Ultra-violet rays, produced by a mercury vapor tube, penetrate infected wool, destroying disease germs

Coastal Motor Boat Must Dodge Own Torpedoes

IN RECENT tests on the Thames River, England, armored coastal motor boats destined for the United States navy, clipped off a two hours' run at a speed of 46 miles an hour.

The miniature vessels are only 45 feet in length and eight feet six inches in beam. Each is driven by a 12-cylinder 375-horsepower gas engine, which in turn is started by a small 2¾-horsepower auxiliary engine. Equipment for two depth charges and two 18-inch torpedoes is included as part of the armament.

From the stern of the little speed craft, torpedoes are discharged along the two troughs shown in the above photograph

The hull is constructed of two-ply mahogany with canvas between the layers to insure waterproof construction. In general, the hull design follows that of hydroplanes with a step beneath for lifting the bow out of water. Thus the draft at full speed is only a few inches. For carrying and releasing the two torpedoes, two troughs, formed of mahogany boards, are provided in the after portion of the boat. Along both sides of the troughs are oak runners faced with strips of manganese bronze, and the torpedoes, which lie in the troughs, are fitted with angle brackets that rest on the runners.

One or both torpedoes are discharged over the stern while the boat is traveling full speed in the direction of the objective. Since the torpedo travels in the same direction, the course of the boat is altered as soon as the deadly missile is launched.

The torpedo is aimed by bringing the pointer of a director gear, the stem of the boat, and the objective in line, and is discharged by the usual torpedo tube.

When the boat is to be used for mine laying, the mines are carried in the torpedo troughs. Sling plates are provided for lifting the craft out of water and carrying it aboard a mother ship.

Cider Barrel Becomes a Talking Machine

SOMETHING strictly new in musical instruments has been evolved by William T. Weinshank, of Chicago, who converted a cider barrel into an attractive phonograph at a cost of only $11.75.

After thoroughly cleaning the barrel, Mr. Weinshank cut double doors in the top side with a keyhole saw and swung the doors on hinges. A second hand spring motor and tone arm suspended from the inside of the barrel completed the works. The crank protruded from one end.

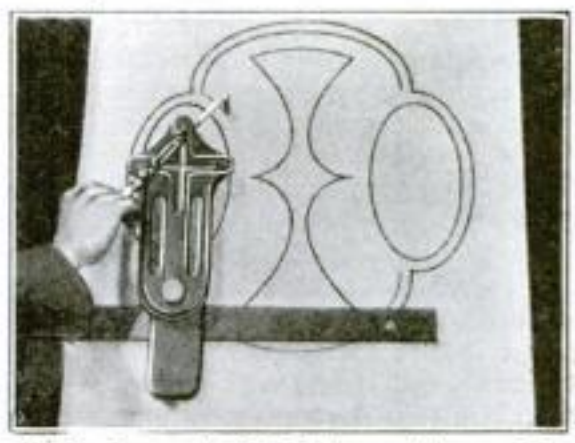
To give the talking machine a finish, the barrel was placed on a special support into which the circular heads fitted, and, as a final realistic touch, Mr. Weinshank added a spigot.

ONLY 30 per cent of the wood in a forest reaches the form of seasoned, unplaned lumber, government reports show.

Draftsman's Instrument Will Draw Ellipse

BASED on the theory of the ellipse—that the two axes have a definite relation to each other throughout the path of the curve—an instrument has been devised for draftsmen that readily draws ellipses of any size from one by two inches to 11 by 15. The geometrical figures can be drawn in any position with one circular motion.

The entire instrument, which is made for attachment to the regulation T-square, is 12 inches long, two inches high, and three inches wide.



Designing of intricate patterns is simplified by this instrument attached to T-square

National Kilograms Marvels of Accuracy

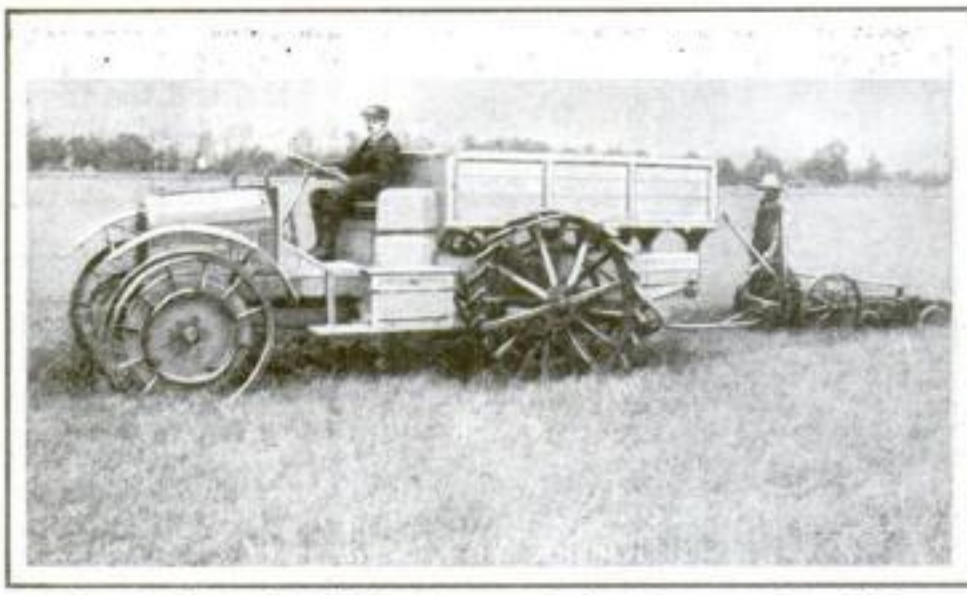
AT THE Bureau of Standards in Washington, D. C., are two small cylinders of whitish metal, insignificant in appearance, yet of tremendous importance to the scientific and technical world. They are the two national kilograms on which scientific weighing in the metric system is based. They stand just an inch and a half high, and their diameter is the same as their height.

These two chunks of metal, preserved under glass covers in a vault, have recently been used to verify the precision working standards in use at the Bureau for many years. They have also been checked by comparing them with each other. The results are most satisfactory.

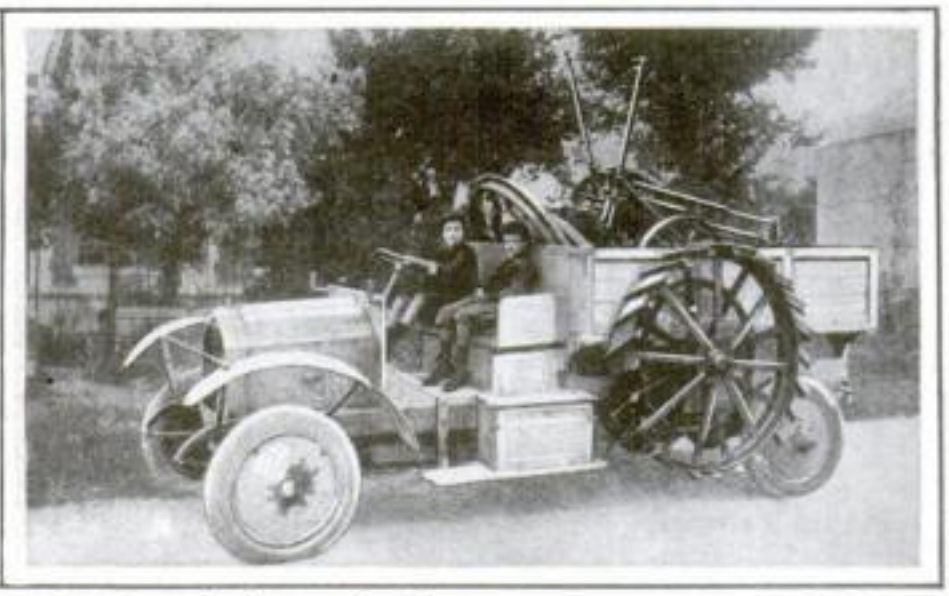
The comparisons of the working standards with the national standards were made with an accuracy corresponding to one part in 100,000,000. In other words, if one of these kilograms were regarded as being owned equally by every one in the United States, the removal of the share of one person from the whole could be detected. The agreement between the two national standard kilograms was even closer than this. On comparing the weighings, the final results checked out exactly to the last figure to which the computations were carried.

Each of the two national standard kilograms is protected by double glass covers, as shown above

Quick Change of Wheels Converts Truck into Tractor



For work in the field, the truck wheels are replaced by ground gripping tractor wheels of large diameter



On the road, the truck rides on pneumatic tires, with the tractor wheels slung at the sides

THE amphibian plane now has its rival in a combination truck and tractor recently developed in France. Like the land-and-water plane, it carries two sets of running gear, one for each class of work.

For road travel, ordinary pneumatic tires are used. But when the machine reaches a field to be plowed, the rear wheels are replaced by ground gripping tractor wheels and the front wheels are supplied with rims of larger diameter. The tractor wheels are driven by means of a link belt from gears on the rear axle.

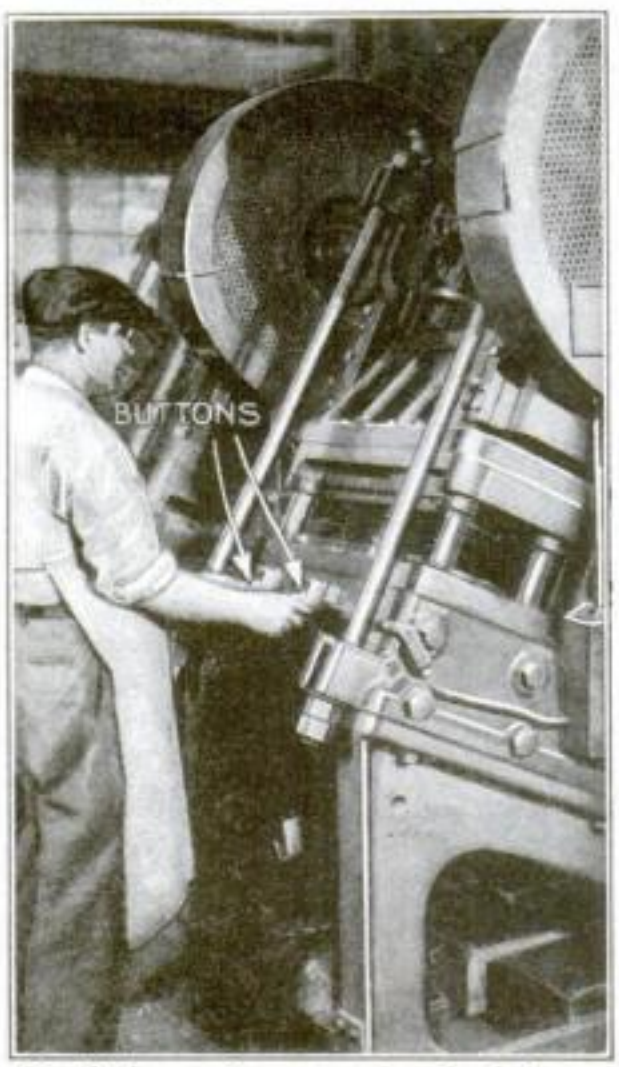
In highway travel the machine with its 18 horsepower, four cylinder engine, can make 19 miles an hour. As a tractor its speed is reduced to about six miles.

Pushbutton Trips Save Fingers of Workmen

PUSHBUTTON tripping devices that require both hands for operation constitute one of the safety measures in the stamp press department of a Detroit automobile manufactory.

Since the pushbuttons are separated a distance of one foot and require both hands to actuate them, it is impossible for the heavy stamp to descend until the workman's fingers are out of the way. The same degree of safety is attained in machinery attended by two or more men by providing two pushbuttons for each workman.

In addition to the reduction in accidents through the use of these controls, the fatigue of foot tripping mechanisms is obviated.



Until the workman pushes both buttons, the heavy stamp cannot descend

Stableboy Turns Crank to Curry the Horses

DISSATISFIED with the old method of currying horses by hand, a French mechanic has invented a revolving brush that does the same work quicker and better.

A cylindrical brush with stiff bristles is equipped with a shaft that fits into a hand driven device similar to the common breast drill. A crank with a wide sweep gears up the speed of the revolving brush. To operate the device, the stableboy places the support of the curry brush against his chest, grasps the shank of the brush in his left hand and turns the crank with his right.

This Small Movie Machine Uses Flashlight

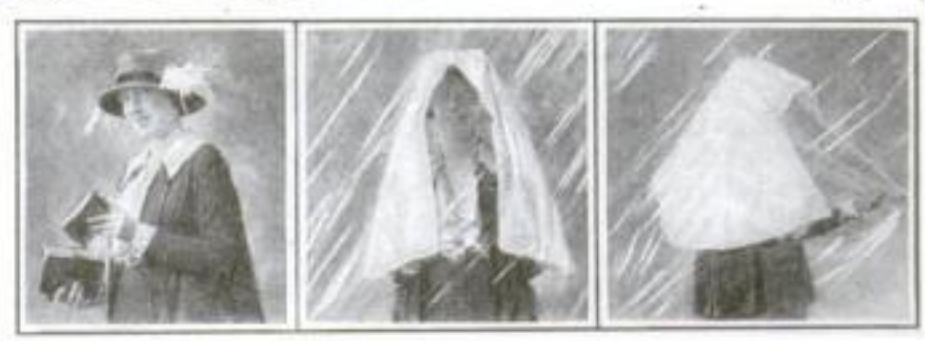
MINIATURE motion-picture machines that use ordinary flashlights as the light source and produce sufficient illumination to exhibit pictures in the daytime have been developed for home entertainment and commercial purposes.

The flashlight rests on a base containing the intermittent mechanism of the device. Sprocket wheels turned by a crank engage the film and draw it through the gate in front of the light source. Special non-inflammable film is used.

How the flashlight projects the film

A Rain Cape of Paper Folds into Handbag

AN EMERGENCY rain cape that can be carried in the purse until opened for use in protecting a woman's hat and wraps from sudden showers, has been recently devised by Joseph A. Gavin, a resident of New York City.



The cape is made of waterproof, watertight paper in black, white or tan. The paper is odorless and sufficiently durable in texture to be used several times if handled carefully.

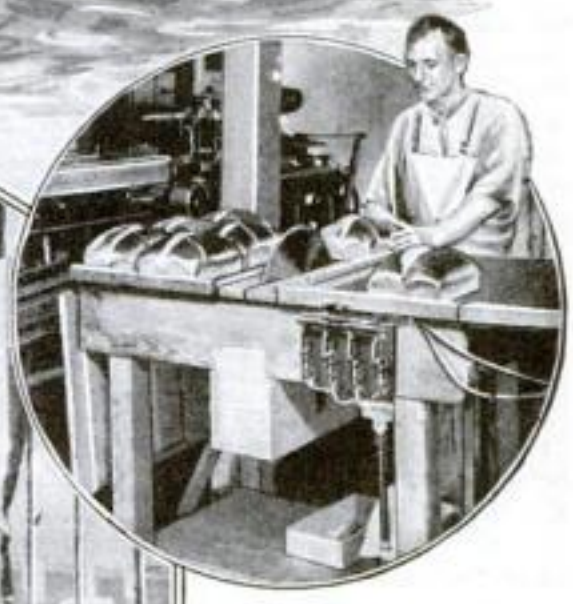
Some Current Sidelights on Human Ingenuity

Sport on Water Shoes

Tilting on "water shoes" is an exciting water sport introduced in Los Angeles, Calif. The shoes are tiny boats with hinged paddles that press the water when the tilter pushes backward with his feet.

Ask the Police

A thousand questions a day are answered for the public at a police department information booth recently established in the heart of Detroit, Mich.

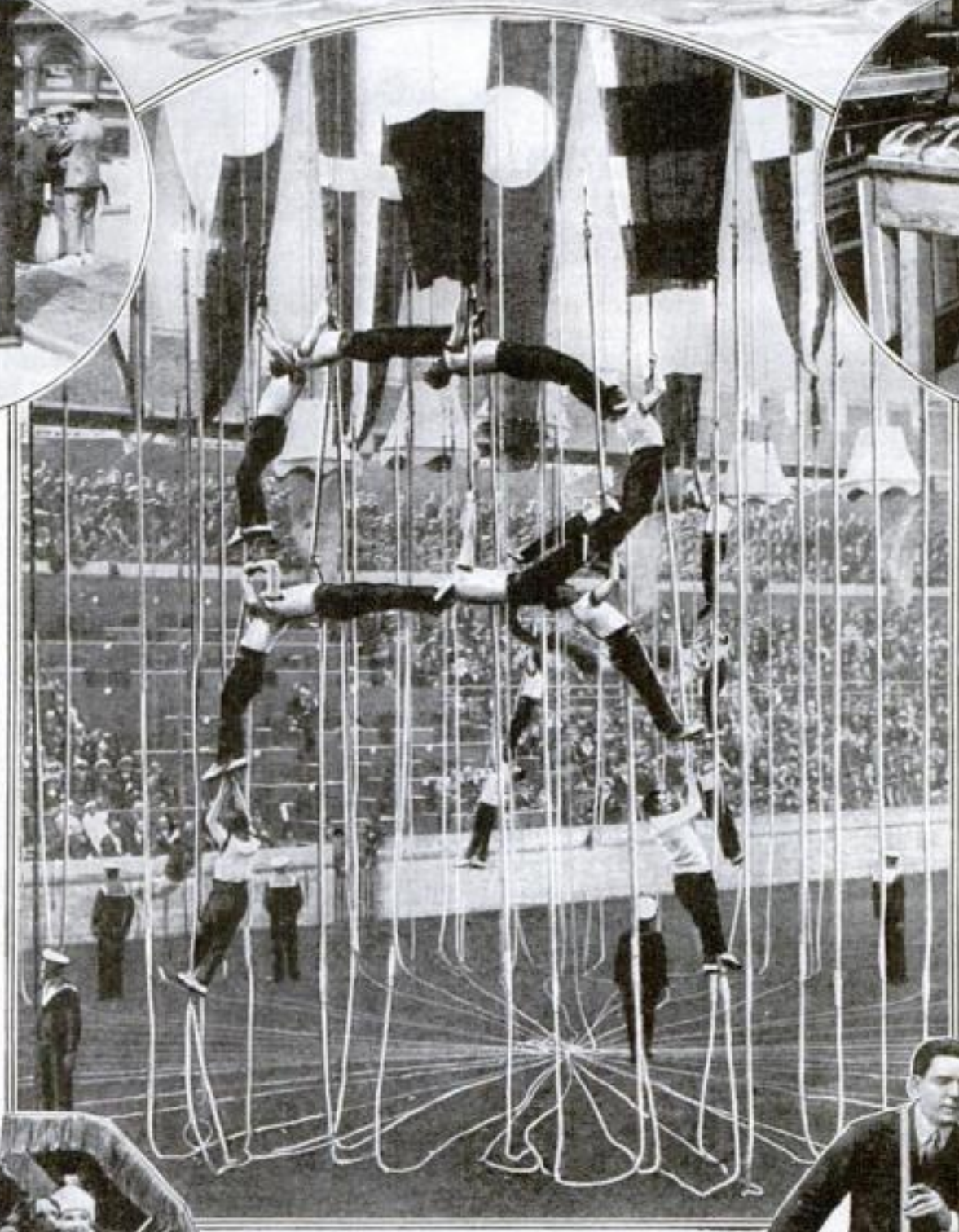


A Bread Saw

Loaves of bread, baked in pairs, are cut apart by a small motor driven circular saw recently adopted in bakeries to prevent uneven breaking of loaves.

Nurse Is Chauffeur

Nurse and baby both ride on a motorized perambulator that recently appeared in London, England. A traction cycle wheel back of the carriage, driven by a small gasoline motor, propels the vehicle.



How Jackies Can Climb

Interesting feats of strength and skill were performed by stalwart lads of the British Royal Naval School at a recent rope climbing exhibition at the Olympia, England. Clinging to a network of ropes, the future mariners, poised in the air, formed group figures, such as shown above.

A Radio Violin

With a one-string violin, Broadcaster Joseph J. McCrann, of Lowell, Mass., transmits music by radio. In the photograph Mr. McCrann is showing how weak tones can be amplified by a radio loudspeaker.

Machine Carves Portraits from Photograph

New Automatic Drill Will Compete with Sculptor's Chis as Camera Does with Artist's Brush

PHOTOGRAPHS deftly reproduced in bas-relief out of ivory, alabaster, or wood, a few hours after a sitting, are the outcome of an extremely ingenious method of photo-sculpture invented by Howard M. Edmunds, of England.

By this device the tedious hours of posing for a sculptured relief or a bust are eliminated. Sculptors need no longer work from living models, but from special photographs made in three minutes' time. Copies of intricate statuary, friezes, decorative pediments, and similar reliefs can be reproduced with a fidelity to surface and texture that defies the closest comparison with the original model.

Spiral lines projected from a stereopticon to the subject's face are photographed by a camera offset at one side. These lines, reproduced on a sensitized plate, serve as a guide for the sculpturing machine

Mr. Edmunds' method combines the arts of photography and sculpture. Although worked out and developed at present as a manual process, there appears to be no fundamental reason why automatic machines cannot eventually be arranged to carry out the reproduction with only the oversight of an attendant.

To produce a bas-relief of a living subject the subject is placed before a camera. A magic lantern or stereopticon beside the camera throws a beam of light on the subject's face. In the slide groove of the lantern is placed a transparent glass plate, bearing on its surface a series of finely drawn black lines arranged in spiral form like the spirals of a phonograph record. First, the lantern is focused so that the lines on the glass plate appear sharp and distinct on the face of the subject.

"Blocking Out" the Portrait

When they are viewed through the lens of the lantern, these lines preserve their parallel structure; but at one side, in the position of the camera, the lines are no longer parallel. They seem to sag at certain points. Further examination discloses that these deviations occur whenever the contour of the subject's face recedes from the camera. The greater the recession, the greater the divergence of the lines. By focusing the camera on these lines a record is made of them and used later to carve out the facsimile of the subject.

The negative print is developed and then enlarged to the desired size of the relief. Since enlargement on bromide paper would insert a possible distortion in the fine lines due to uneven shrinkage of the paper, Mr. Edmunds enlarges his prints on sensitized opal glass. After enlargement the print is projected back to a parallel plane to detect any distortion due to optical errors in the lenses. These errors are carefully corrected before the plate, called the guide plate, is inserted in the machine for the carving operation.

Plate Guides the Drill

The guide plate is placed in the carving machine with the line of displacement of the spiral lines parallel to the drill. Above the guide plate, and connected solidly with the drill, is a microscope with cross hairs in the objective. The drill is fixed mechanically so that it moves in and out along its length, but cannot move sidewise. The guide plate is to a compou ment that rot a spiral exactl to the norma that was proje the face of the s

The motion guide plate is al parted to the ick that holds the blo ivory, wood, alabaster, or bronze out of which the work of art is to be carved.

The operator moves the hand lever until the intersection point of the cross hairs of the microscope lies on the end of one of the spiral lines of the guide plate. The motors are then started, the steel carrier and headstock begin to rotate, and all the operator has to do is to move the hand lever so that, as the guide plate rotates, the intersection point of the cross hairs of the microscope follows the same spiral line from end to end. Since the lines on the guide plate are distorted from the true spiral, the movement of the bar causes the drill point to move as well, and so to cut a deeper or shallower groove, according to the amount of distortion. Thus one groove after another is cut in the material.

The fineness of the finished work depends on the closeness of the lines that guide the drill. If only a few lines are used, the finished relief will show the spiral paths of the drill. In practice, Mr. Edmunds has found that 20, 40, and 100 lines an inch can be used with satisfactory results. When 100 lines are used, the grooves in the finished carving are so fine as to be scarcely noticeable. They are no more evident than the minute dots that compose the half tone illustrations in this page.

This guide plate shows the face covered by the spiral lines. The straight horizontal line assists in adjusting the machine

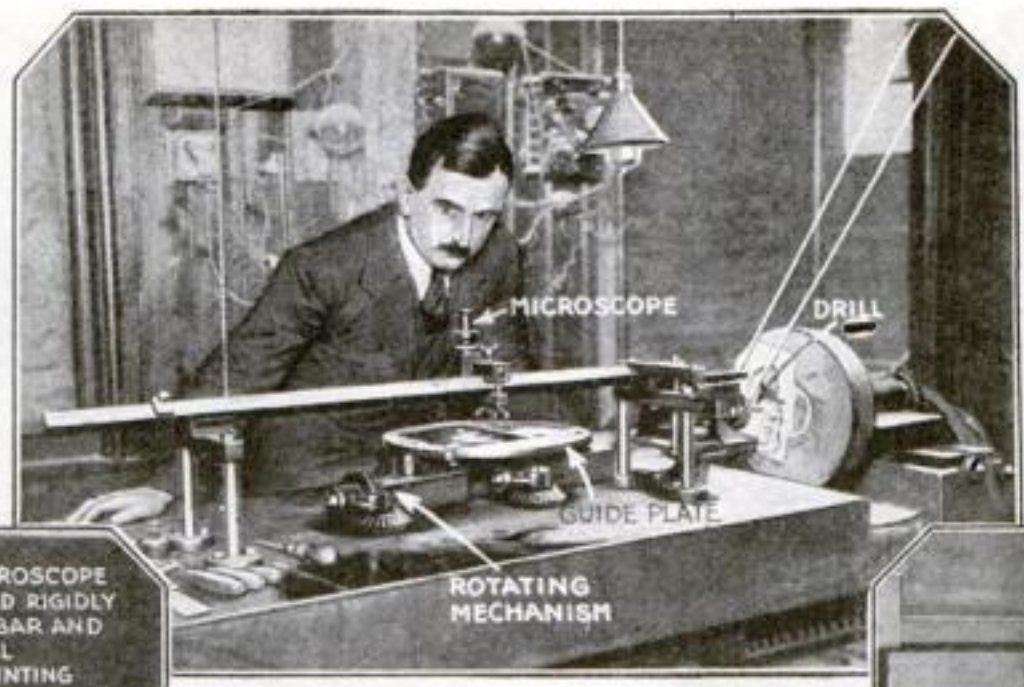
Relief Can Be Varied

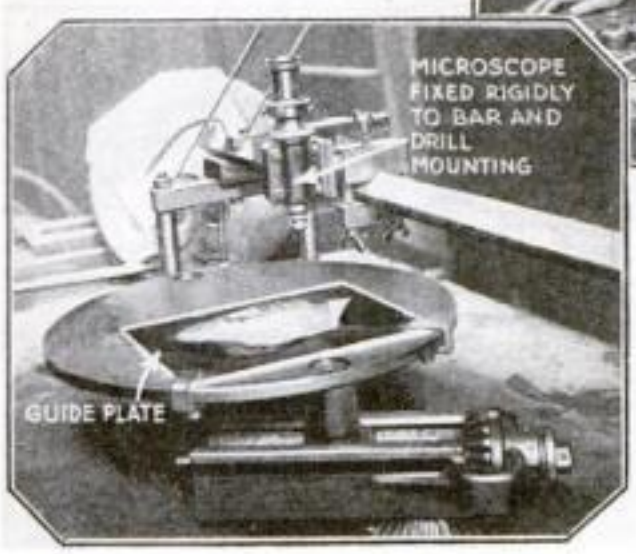
By changing the position of the camera that records the spiral lines the degree of relief can be varied. If the camera is placed near the stereopticon, sculptured relief will be shallow, but by increasing the distance between the two instruments, the depth can be greatly increased.

The amount of labor required to complete a photograph in relief depends upon the size and the fineness of the surface desired. The work cannot be hurried. A guide plate containing 200 spiral lines can be completed in eight hours. One false move after hours of work will completely ruin the carving, but after short practice an operator becomes sufficiently proficient to eliminate the probability of disaster.

While the inventor has not attempted to prophesy the future of the invention, scientific bodies recog-

nize in it a method that will make possible the reproduction of the works of the old masters on any scale and to any degree of relief. Friezes and sections of pediments located in difficult positions for extended study by a sculptor could be photographed and reproduced in perfect detail. By reversing the action of the machine it is thought that concave engravings in the form of dies for pressing medals could be readily produced. It is well within the realm of reason that just as the photograph made possible the enjoyment of great paintings by multitudes of people, photosculpture will bring about universal appreciation of masterpieces of sculpture now available only to those who can afford to visit the large art galleries where they are exhibited.





Above is Howard M. Edmunds, the inventor, at work on his machine. The drill at the right is carving a bas-relief from a block of alabaster

The guide plate of opal glass containing the spiral lines is attached to a motor driven table, as shown at left

A rapidly turning drill, shown at right, moves against the piece of work as the microscope follows the guide plate lines

Wind Operates Traffic Signal Light

BY COMBINING the anemometer, or wind gage, with a silent policeman, the city of Detroit has produced a wind operated safety signal for traffic that cannot fail to attract attention.

At the top of the pedestal, which is heavily weighted at the base, is a red globe containing a powerful electric bulb burning continually. The shaft of the wind gage, mounted above the globe, passes into the globe, where it is attached to revolving opaque blades.

As the prevailing wind drives the cup shaped gage, the vanes rotate around the light bulb, producing flashes of varying duration, depending entirely upon the strength of the wind.

Small cup shaped vanes, rotated by the wind, operate this silent traffic policeman

Road Roller Rides to Work on a Trailer

TO FACILITATE moving heavy road rollers from one job to another, the Board of Public Works of the city of Detroit has devised a trailer equipped with a special reinforced tailboard, up which the roller can be run under its own power. This trailer with its 10-ton load can be moved at eight miles an hour, while the roller makes but three on its own wheels.

Light Rapid Fire Gun Has Only 38 Parts

A NON-RECOIL submachine gun that can fire 1000 rounds of ball, shot, or slug cartridges in one minute and nine seconds, has been invented by John T. Thompson, a retired general of the United States Army.

The weapon consists of 38 parts, in contrast with the usual 200, and weighs 10 pounds. It can be fired in single shots or in "bursts" like the ordinary machine gun.

Firing the non-recoil gun with its butt held against the nose

Mounds of Earth Serve as Pipes for Coolies

ALTHOUGH coolies in India and South Africa cannot take their favorite water pipes with them when on the march, they find a satisfactory substitute in earth pipes constructed along the way.

In South Africa the pipe is built up on the ground surface by heaping a little mound of earth and making a small tunnel through it. The tobacco is placed at one end of the opening while the native, kneeling at the other, sucks in the smoke.

In Natal and Rajputana the pipe is a sunbaked tube of clay hollowed out in the shape of a cone.

How coolies make and use their strange earth pipes

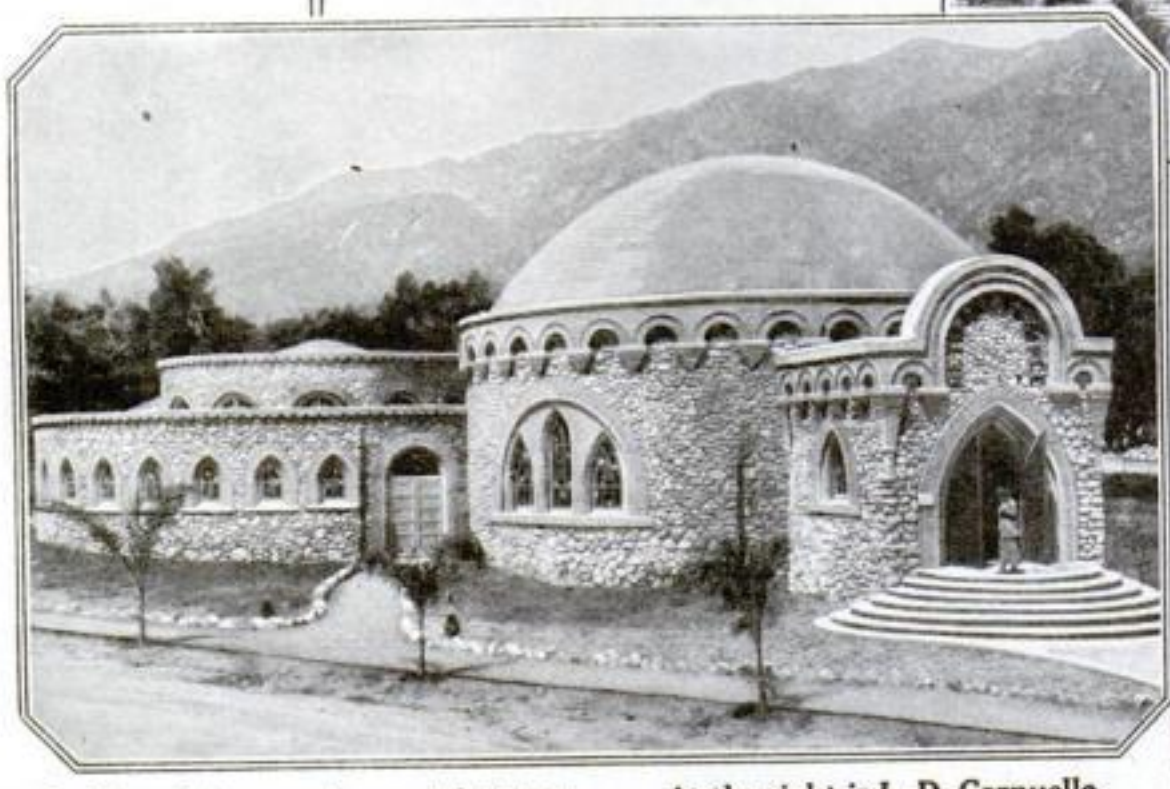
One Man Builds Domed Church

COMBINING in its wide sweeping dome, its windows, and cornice decorations, interesting features of both Greek and Norman architecture a unique religious edifice under the name of Bethany Temple, has been constructed in the city of Sierra Madre, Calif., by one man. Nothing about the edifice is professional. All the materials were taken from near-by sources.

The temple proper is 52 feet in diameter and 30 feet high from ground to top of dome. A second building, which houses the Sunday school, is 57 feet in diameter and 18 feet high. Both structures are built of cement blocks with a facing of smooth granite stones lifted from a near-by mountain stream.

Extensive as the buildings are, the entire construction work was done by a local artisan, L. D. Cornuelle, under supervision of the Rev. W. H. Rawlings. It required a year and a half to complete the structures.

The sweeping arches of the church and the semicircular windows under the eaves are shown in the interior view at the right. Note the excellent finish of the auditorium



Gothic windows and graceful domes with walls of stones taken from near-by streams were selected by the designer to distinguish Bethany Temple, a religious center at Sierra Madre, Calif.

At the right is L. D. Cornuelle, who constructed the buildings. His ingenuity enabled him to erect the walls and domes alone and without the customary extensive staging

In building the temple and school, Mr. Cornuelle adopted an unusual method of scaffolding. After the course had been carried to a point as high as he could reach from the ground, a spring wagon was drawn alongside and used as the staging. When the new height had been overreached, a platform was erected and up this the wagon was drawn. As the tier spread to one side or the other, the wagon was shifted along the platform. Later a staging was built upon the wagon and this gave the necessary height for the completion of the walls.

Only the dome is of wood; all else is concrete. Departing from the usual method of dome construction wherein the rafters supporting the dome are sawed to shape, Mr. Cornuelle bent one-by-three timbers to the required curvature and then nailed several of them together to give rigidity. Over the rafters he placed lead covered asbestos paper well sanded with broken gravel to match the concrete and stone of the walls.

The edifice is illuminated by indirect lighting in invisible fixtures in white and soft colors that can be manipulated at will.

Oil Rams Tip Truck Body to Right, Left, or Rearward

BY MEANS of oil operated rams controlled by an oil pump driven direct from the truck engine shaft by friction disks, a remarkable new cart body can be tipped for dumping from sides or rear. The entire apparatus weighs only 200 pounds.

The two rams, placed inside the chassis frame just forward of the rear wheels, consist of slender cylinders in which the pistons are moved by the pressure of oil fed into the casings from an oil pump. A reservoir holding about a gallon of oil is suspended from the truck frame under the driver's seat. The force pump is built into the reservoir.

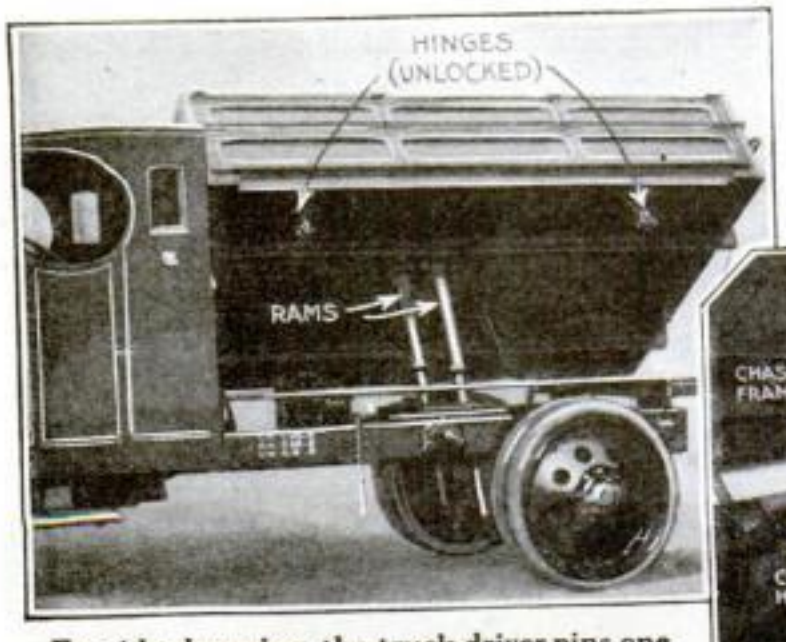
In the driver's compartment a friction wheel handle controls the motion of the oil pump and a hand operated valve permits the oil to return to the container when the tipped body is lowered.

Although one of the rams travels a greater distance than the other in tipping the body to one side, automatic valves provide for the same pressure in each ram.

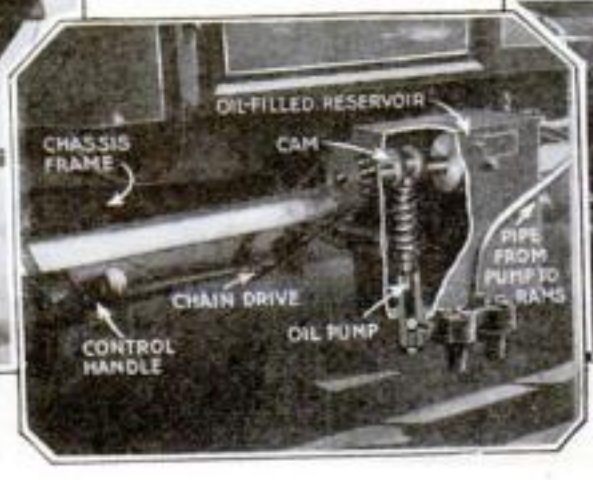
When the body is lowered, the rams have sufficient clearance to avoid damage from roadway obstructions.

The direction of tip is controlled by the driver, who pins or locks certain hinges. Since the body normally floats without rigid fastening at either side, the dumping side must be pinned before the rams are started.

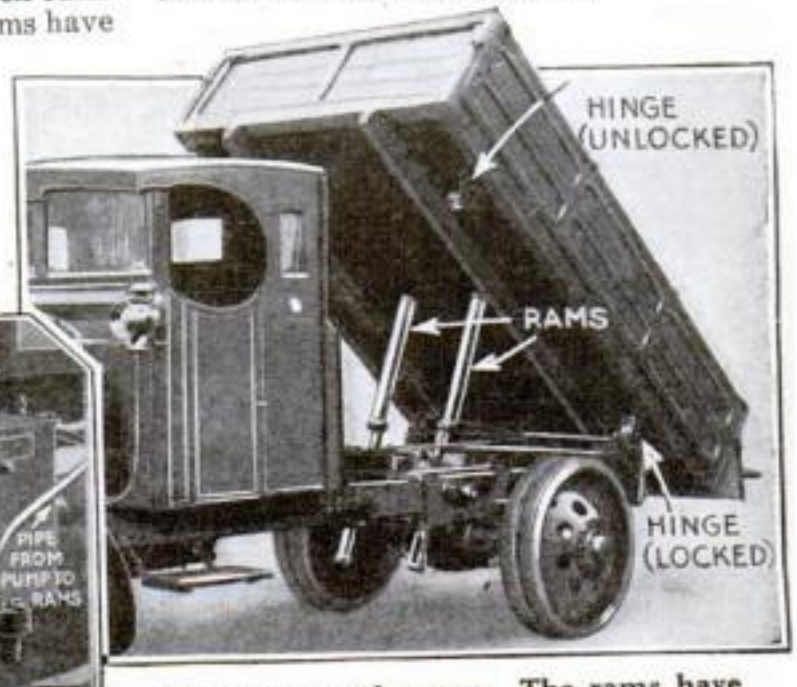
The dumping mechanism has been found to work efficiently on lubricating oil removed from the truck engine.



For side-dumping, the truck driver pins one side, unhinges the other, and throws the control handle



The oil reservoir under the seat contains a cam-driven oil pump and an automatic valve that holds the rams when extended

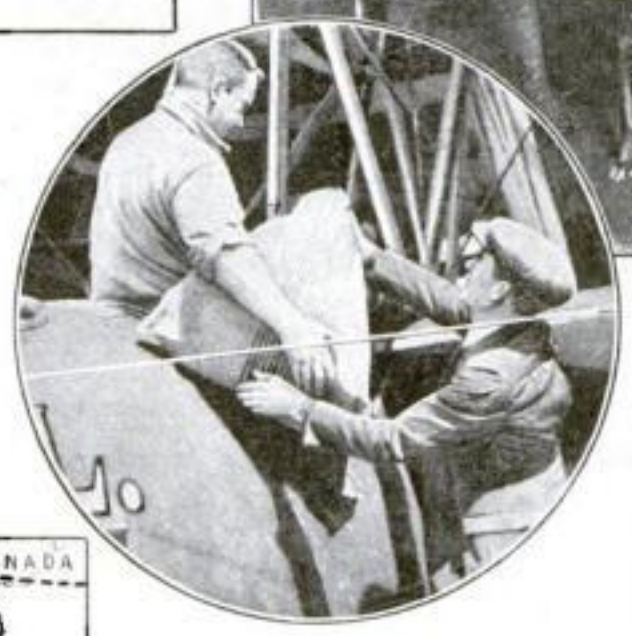


Dumping to the rear. The rams have sufficient clearance to pass over any obstacles cleared by the rear axle

How Eddie Hubbard Makes Flying Pay

HERE is the story of an enterprising American aviator who runs probably the only one-man air line in the United States and makes a good living from it. His success is interesting confirmation of what Glenn H. Curtiss said in the July, 1922, POPULAR SCIENCE MONTHLY concerning a young man's chances of making money in commercial flying.

You will enjoy reading how Eddie Hubbard, as the pilot of his own United States mail route, has been clearing over $80 a trip, while maintaining the traditions of the service for punctuality.



As proprietor of what is said to be the only one-man aerial express service in the country, Eddie Hubbard, of Seattle (second from right above), recently took on the dramatic job of rushing bloodhounds and detectives to the scene of a bank robbery, thus foiling the escape of the criminals

SAID to be the only commercial aviator in the country who is making a financial success of a regular flying route, Eddie Hubbard, of Seattle, carries United States mails in his seaplane on an ironclad schedule 10 times a month between Seattle, Wash., and Victoria, B. C., a distance of 84 miles.

Assistant Postmaster Otto Praeger, in 1920, foresaw a saving in time if mail for the Orient could be handled by plane between Seattle and Victoria. Bids were called for. Hubbard won, and has had a continuous contract ever since.

Eddie Hubbard, above on the right, helps to put aboard some of the 24,000 letters that he carries regularly on his air mail plane. The map at the left shows the route covered by the Seattle-Victoria mail line and explains why the seaplane gives water-locked Victoria its most satisfactory means of communication with Seattle

Flying through thunderstorms, bucking the gales of winter and the storms of early spring, Hubbard's plane gives eight hours' faster service than the fastest boats. And sometimes the boats are held in quarantine. This can never happen to the plane. Ten times a month, 120 times a year, Hubbard and his plane deliver letters in Victoria three hours after loading the plane in Seattle. The government demands 100 per cent efficiency and Hubbard has never failed.

Only first class mail is carried. Hubbard's plane carries about 600 pounds of mail, averaging 24,000 letters.

For each round trip Hubbard receives $200. He uses 35 gallons of special gasoline costing $10.50 and one gallon of oil at $1.10 a gallon. But his greatest expense is the depreciation of his plane. Its life is only 500 hours of actual flying, which means that he must charge off one five hundredth of the purchase price of $13,000 each hour he flies. A second big item is the insurance on the plane. Insurance companies charge a premium of 25 per cent of the insurable value, which is $10,000. So $2500 must be paid each six months, since his plane is never insured for longer periods. Adding these charges together, it is seen that out of the $200 paid by the government for each round trip, Hubbard must deduct $112.26 as "overhead," leaving him a clear profit—barring serious mishaps—of about $88 for each trip.

Since Hubbard's mail delivery takes only 10 days a month, he uses the remaining time to make money with his other "ship," which he rents out for one dollar a minute.

He is sometimes called upon to help in running down criminals. A few months ago he carried two deputy sheriffs, a reporter, and two bloodhounds in his plane to Sequim, Wash., where two bandits had held up and robbed a bank. A few hours after the dogs had been liberated, the robbers were in custody. If the dogs had been sent by train, the pursuit would have been delayed 12 hours, giving the thieves time to make their escape.

There is nothing of the daredevil in the appearance of Eddie Hubbard. He is known to be absolutely fearless—his term as a flying instructor at Rockwell Field during the war proves it; he never indulges in spectacular stunts.

Cement Filled Shell Boxes Form Bricks for Rebuilt Homes

BOXES in which shells were transported to the front during the war are now being used in the battlefield districts to rebuild homes. The boxes are first filled with cement and allowed to dry.

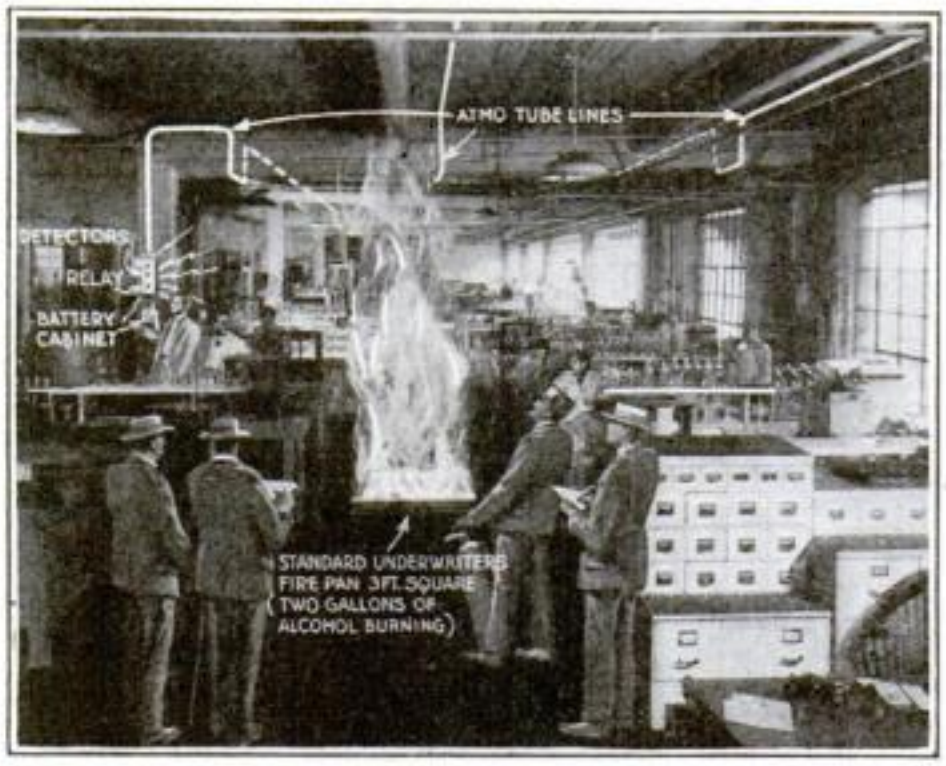
They are then assembled like hollow tiles, forming walls of great strength. Above at the left, workmen are tamping the cement in place. At the right is shown a pile of the discarded boxes.

Sensitive Air Tubes Detect Fire and Ring the Alarm

EMPLOYING a principle new to automatic fire detection apparatus, a pneumatic electrical system has recently been devised that will invariably turn in an alarm within 30 seconds after the fire starts.

The new system is based upon the expansion of air in a closed tube rather than on fusible elements, and is so designed as to distinguish automatically between the heat of a fire and a gradual rise in temperature due to near-by steam pipes or heating systems in the industrial plant.

The detector consists of one or more circuits of small copper tubing containing air at atmospheric pressure. The tubes extend across the ceiling or on the side walls of the area to be protected, and are spaced about 18 feet apart. Each end of the tube circuit opens into a diaphragm made from a flexible sheet of German silver 0.002 inch thick. These diaphragms are placed opposite each other, and very close together. When heat from a fire expands the air in the tubes, the pressure is transmitted through the tubing to the diaphragms, causing them to expand toward each other. When the sum of the pressures exceeds a certain set amount, the two diaphragms touch and close an electric circuit, which rings the fire alarm.

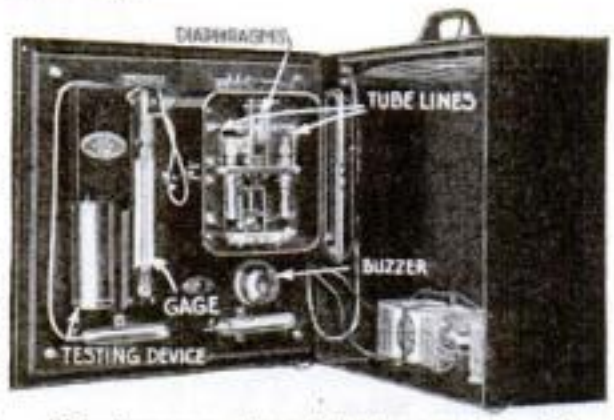


When tested with a pan of burning alcohol, the fire alarm shown in detail at the right, rang the alarm 26 seconds after the fire started on the floor below

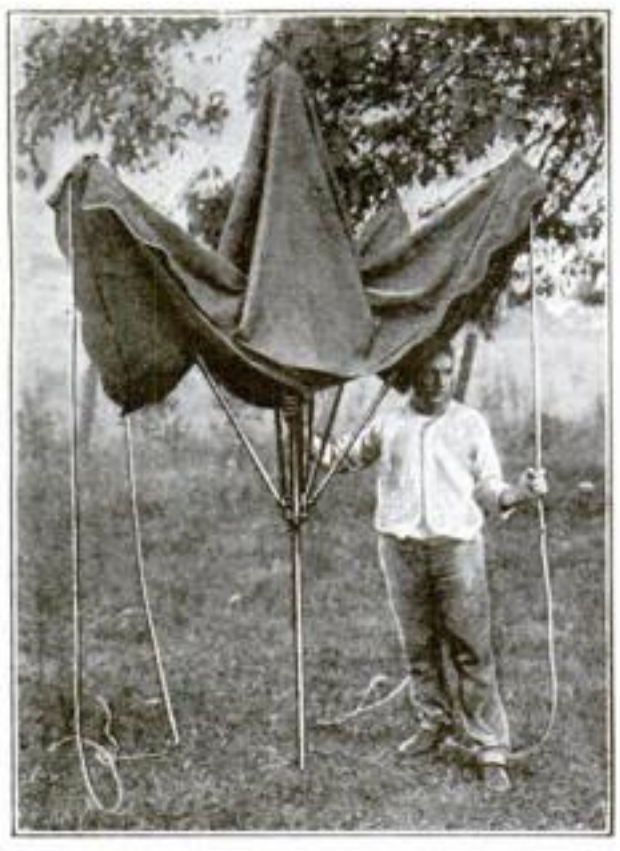
If this were the entire system, however, it would turn in an alarm when the steam heat was turned on, and on every hot day in summer. To make the apparatus unresponsive to weather changes, a fixed vent is inserted in the tubes near each diaphragm. If the temperature—and therefore the pressure in the tubes—rises at less than a certain predetermined rate, these vents relieve the pressure as fast as it is produced. But in case of fire, pressure is built up faster than the vents can dispose of it, and the alarm rings.

Compensating chambers are also interposed between the tube line and the diaphragm to intercept temporary heat effects caused by steam pipes or the work going on in the building where the system is installed. The chambers provide additional volume in the tube system.

The sensitiveness of this system has been demonstrated recently by two official tests made under most adverse conditions.



Diaphragms placed between two air tubes touch each other when the heated air expands, completing an electric circuit and ringing the alarm



Five Room Tent-Bungalow Fits on Runningboard

TENTS built on the unit plan are now available to the automobile camper and tourist. By adding rooms around the outside of a center unit, a five room shelter is possible.

The central unit folds when not in use and opens like an umbrella, with pole and ribs of seamless brass and aluminum tubing. The outside diameter of the tent when folded is only 12 inches, so that it can be packed on the runningboard of the tourist's automobile.

Stage Martyrs Keep Cool in Mock Fire

TO BE burned at the stake is not so uncomfortable—on the stage. Though the fire seems to be eating into the heart of the logs, and the burning embers shoot tongues of flame about the martyr's feet, he is cool, for the fuel of this fire is fireproof.

The logs are made of asbestos built up with wire netting, painted to resemble wood and sprinkled with wood ashes. The glowing embers are only electric lights behind red paper, and the darting flames are long streamers of brilliant red silk that flutter in the air current that arises from a 10-inch electric fan placed at the foot of the pile. A separate battery of red lights that throw a strong glare on the silk streamers gives the remarkable illusion of flame.

Streamers of bright red silk, illuminated by batteries of red electric lights and fluttering in the breeze from an electric fan, are the basis of the darts of "flame" in this stage pyre

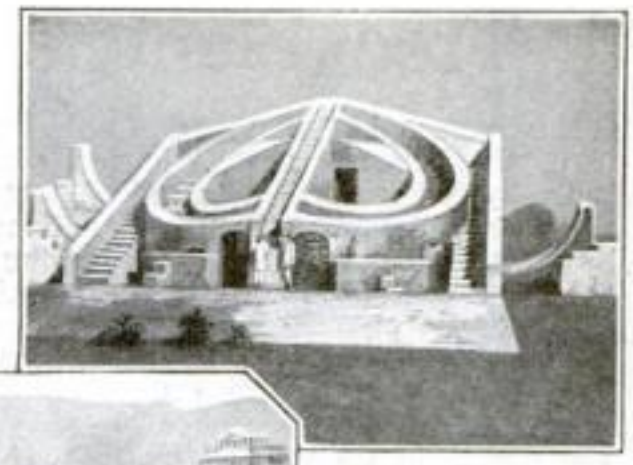
India's Mysterious Star Pointers

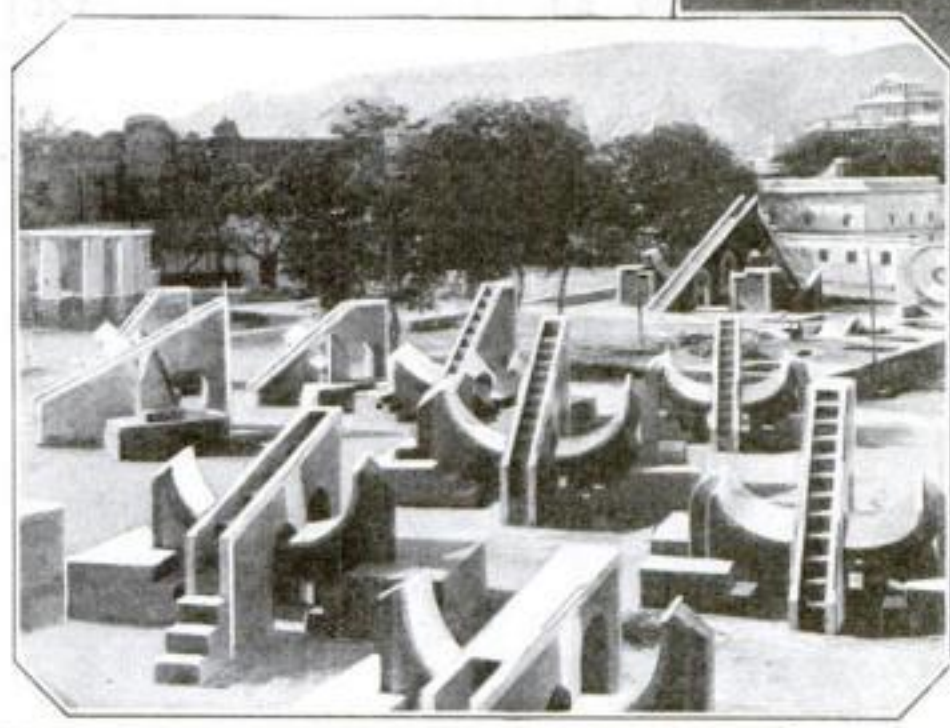
Astronomy for All

THE public's first real chance to observe the wonders of the heavens through the powerful modern apparatus of astronomers has come through the efforts of Professor Frank Schlesinger, new director of the Yale University Observatory, New Haven, Conn. On two nights of each week one of the observatory domes, with its telescope, especially equipped for the purpose, has been opened to laymen. Admission is by ticket obtained by written request to the observatory, stating the preferred date.

The queer pictures of 17th century astronomical devices shown on this page, are in striking contrast to the huge yet delicate instruments of modern observatories. But these Oriental "star pointers" had in common with modern telescopes the one fact they were the monopoly of the privileged few. The step taken at Yale toward revealing the magnificent secrets of the heavens to the public might well be followed by other universities.

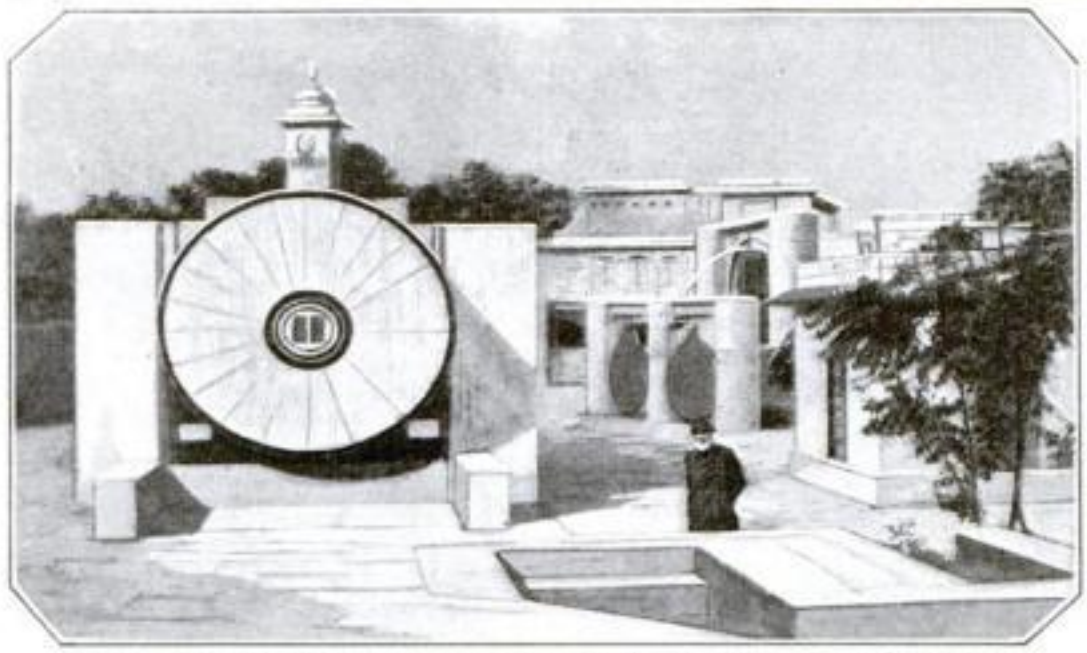
The stone instruments in the strange astronomical observatory at Jaipur, India, shown below, are star pointers, marking spots in the sky where sun or planets reach their highest altitudes on definite days of the year. From these dates the Hindu calendar was corrected





For observing the sun, the above instrument, called "Misra Yantra," was one of the important devices. By placing a pointed stone marker on the central steps and standing on one of the outer flights of steps with his chin on the circular wall, the Hindu astronomer obtained sight lines for plotting movements of heavenly bodies

COMPARED with modern high powered reflecting telescopes that photograph celestial bodies thousands of light years away, the strange stone astronomical instruments pictured on this page appear grotesque. Yet with these queer, blocklike instruments, some of them resembling sun dials, Hindu astronomers gained surprisingly accurate knowledge of the heavens long before the invention of the telescope. Indeed, they were able to calculate an eclipse to the fraction of a minute, and could fix the exact length of the solar year—a complicated astronomical calculation—within a few minutes of the correct measurement.



The vertical, circular stone shown above points north and south. It was used to determine altitudes of stars in the meridian

The greatest Hindu observatory, near Delhi, India, is built of polished marble. The stone "telescopes" were erected in the seventeenth century, and marked the high tide of native Hindu astronomy. The builder was a famous fighting king, the Maharajah Swaai Jai Singh of Jaipur. From his early youth this prince was interested in the stars, and when he found the Hindu astronomical tables and calendar in error, he set out to correct them, sending scientists throughout the East to collect and translate books on the subject.

In correcting the calendar, the maharajah tackled a difficult problem. Since the Hindu year was based partly on the position of the moon, and partly on the position of the sun, and since the lunar year contains 354 days, while the solar year contains 365¼ days, the resulting confusion may be imagined. We still have one survival of the lunar calendar—the date of Easter varies each year because it is reckoned by the moon.

The maharajah solved the complicated problem of reconciling time by the sun, time by the moon, and time by the stars—all different—by erecting his strange stone structures, which in reality are not sun dials, but star pointers. These dials point to spots in the heavens that the sun and certain important planets occupy at certain definite times of the year. One dial points at the sun at the moment of high noon on the vernal equinox. Before the sun again occupies that position at the moment of noon, exactly a year will have elapsed.

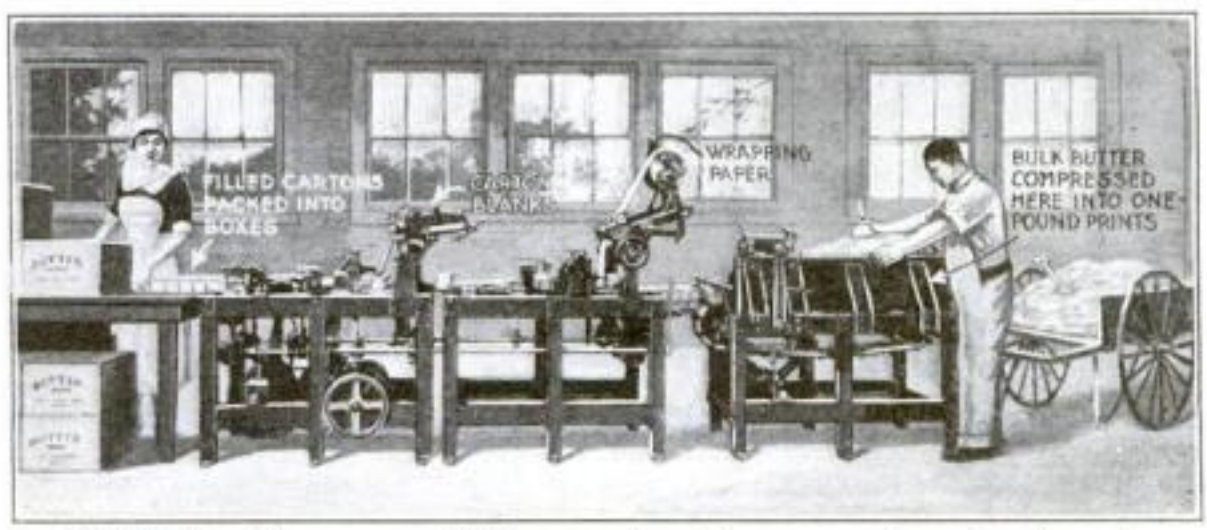
Other pointers mark similar important points for the moon and the planets. Comparing the various readings by observing the positions of shadows cast by the slanting gnomens of the dials, the Hindu astronomer obtained a very close idea of the relations of solar, sidereal, and lunar phenomena.

The observatory also contains an armillary circle and an astrolabe for taking altitudes of the sun and stars at odd times. The dials marked the fixed points and sight lines to which all motions of the stars were referred, making it comparatively simple to chart the apparent motions of heavenly bodies.

Machine Wraps 1500 Pounds of Butter an Hour

WITH a new automatic molding and cartoning machine, two girls and a man can cut, wrap, and deliver ready for packing 1500 pounds of butter or oleo an hour. The machine comprises a molding device with refrigerating attachment, a parchment-folding machine and a cartoning device that places the complete mold in its shipping case.

The butter is dropped into a hopper and passes downward into molds. The refrigerator freezes the butter for packing.



Bulk butter is compressed into pound prints, wrapped, cartoned and packed into boxes automatically by the machine methods shown above

Tree Planters in Losing Race with Forest Fires

IN AN attempt to compensate for the loss of the immense acreage burned over annually by forest fires in the United States, foresters are traveling through the national parks planting thousands of seedlings wherever conditions are right for their growth.

According to surveys by government officials, the national forests now contain over 23 per cent of the remaining timber in the country. In these guarded preserves during 1921, 5851 fires occurred, three quarters of which were due to human agencies and could have been prevented by using ordinary care.

Criminal Carelessness

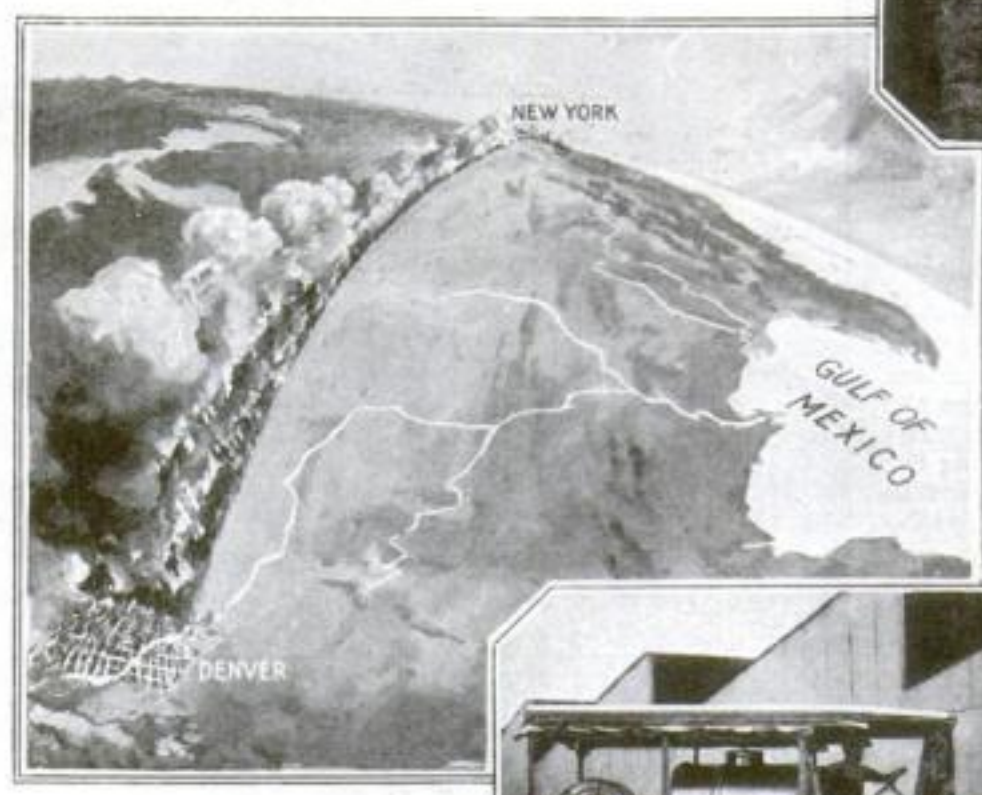
As a matter of fact, 20 per cent of all the forest fires started by man in the national forests of the West during 1921, were caused by careless tobacco smokers. In California, Arizona, and New Mexico one out of every four forest fires due to human agencies was started by burning cigarettes, cigars, matches, or pipe-heels carelessly thrown aside by smokers while in the woods.

An idea of the forest fire havoc wrought yearly in this country is pictured in the report of the National Board of Fire Underwriters, which estimates that the area destroyed would equal a strip of land 10 miles wide stretching all the way from New York City to Denver, Colo.

In reforesting the wasted areas, thousands of seedlings suited to climate conditions are distributed to workers who, equipped with special implements, plant the future forests in open places. The planting tool consists of two pieces of boiler plate sharpened to a point and attached to a long sturdy handle. The point of the spade is pushed into the ground and rocked back and forth until a narrow slit is formed. The seedling is then dropped into the hole and the earth tamped tightly around it. One man with this tool can plant 1000 seedlings a day.

Courtesy U. S. Forest Service

This tree planting tool consists of two pieces of boiler plate with sharpened point attached to a handle



Our Appalling Fire Loss

Forest areas destroyed by fire each year are equal to a strip of land 10 miles wide, reaching from New York City to Denver, Colo. Timber destroyed would build houses for the entire population of a city the size of Washington, D. C.

Fire trucks used in protecting Olympic Forest, Wash., carry water tank, hose, and pump

Trees' Slow Growth

A spruce tree does not reach maturity for 45 years; an oak requires 75 years before it attains size suitable for cutting. For these reasons, judicious cutting, complete fire protection, and scientific reforestation are essential if the forests of the United States are to be saved for the future.

Pronged Club Reveals Faults of Golfer

FAULTS in golf strokes are revealed by a practice golf club invented in England. The driving face of the club, instead of being smooth or slightly corrugated, is studded with needlelike prongs. When the face strikes the ball, these prongs are embedded in the gutta-percha covering, holding the ball fast to the club. After the swing has been completed, a study of the position of the ball on the club face indicates to the golfer the nature of his errors.

Sharp prongs hold the ball to the club

Phonograph Records Made at Home

LISTENING to yourself is made easy by a new phonograph recording set. A pivot fits over the center post of the record table and supports several horizontal rods, which terminate in a second support on the outside of the revolving plate. Just above the pivot is a rubber friction disk that drives another friction disk.

These disks transmit the driving power from the record table to a finely threaded horizontal rod to which the reproducing stylus and diaphragm are attached. The remaining rods serve as supports.

To make a record a smooth wax disk is placed on the platen. The reproducer is started at the outside edge of the disk.

As the platen rotates, the friction disks move the cutting stylus toward the center, and the performer's voice, entering the horn strikes the diaphragm, causing the sharp stylus to cut grooves in the wax.

The singer's voice is reproduced on the wax record by a cutting stylus moved by friction disks

Camera Keeps Pace with Invention

This Pitcher Never Tires

Ty Cobb shows how the latest batter-practice machine operates. As the man at the right turns a crank, the revolving arm on the top of the machine causes the ball attached to the cord to swing rapidly in a 34-foot circle in the direction indicated by the arrows. The batter tries his skill to prevent it from making the round trip.

Color in the Home

By changing the color of the lighting with these patented parchment shades, the illumination of the home may be altered to please the owner's mood. Red stimulates, blue soothes, and green has a recuperative effect.

Plaster Pies for Movies

Pies and pastry—the kinds that are thrown but not eaten in movie comedies—are produced by sculptors who use plaster of Paris instead of flour. So far, no satisfactory substitute has been discovered for the mirth provoking custard pie.

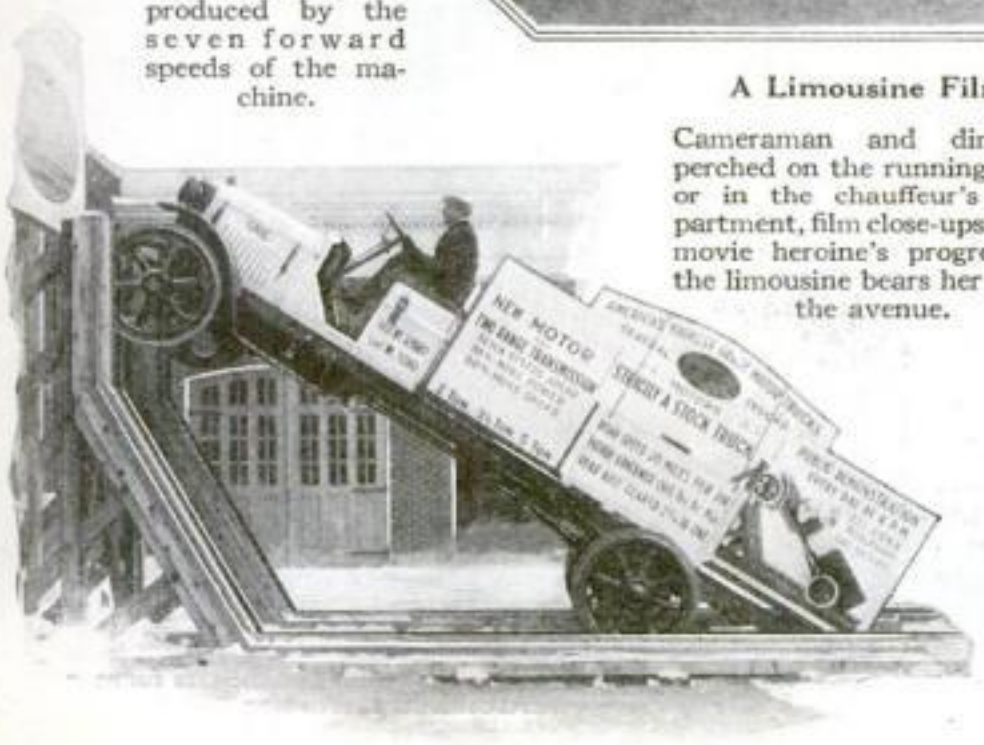
Courtesy Paramount Pictures

Truck Climbs a Wall

To test the tractive power of a two-ton motor truck, its maker drove the front wheels up a vertical incline. The stunt was conceived to demonstrate the power produced by the seven forward speeds of the machine.

A Limousine Film

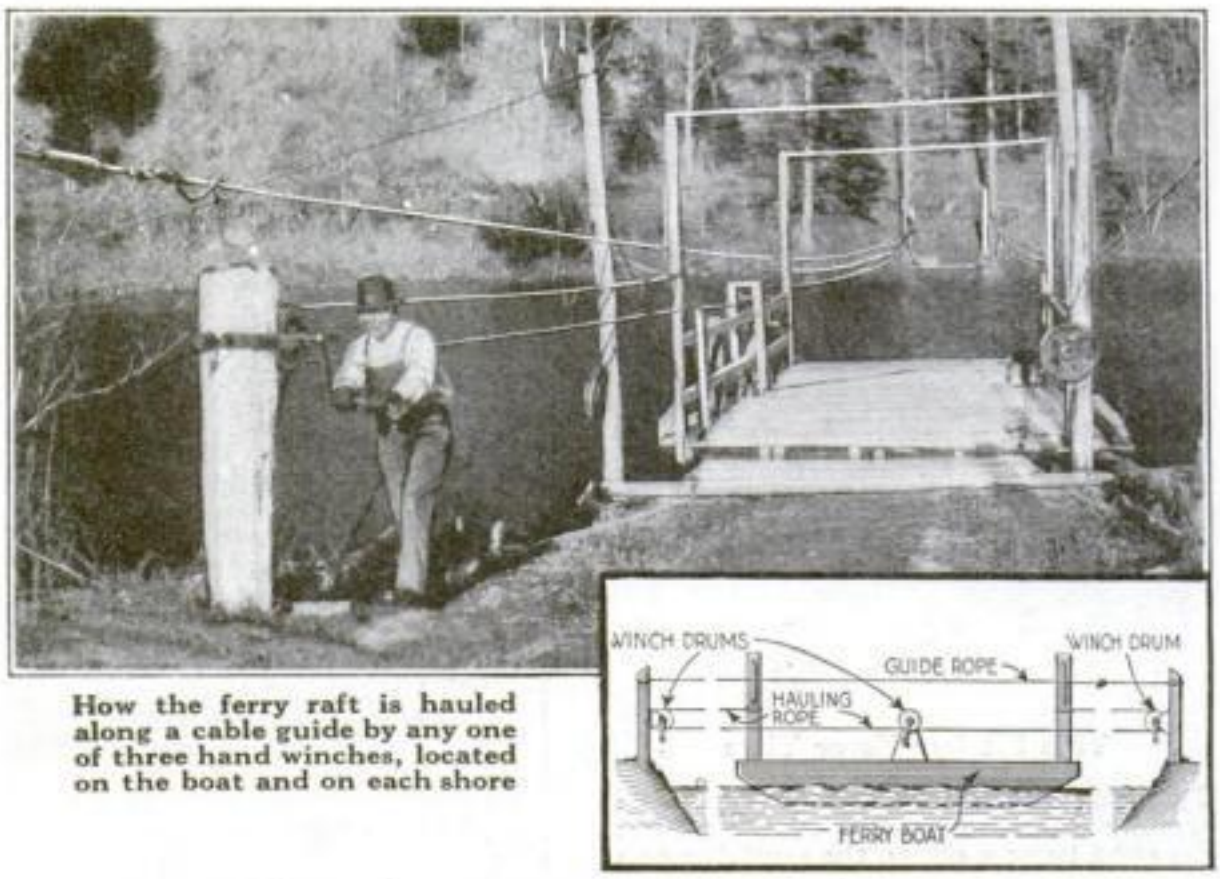
Cameraman and director, perched on the runningboard or in the chauffeur's compartment, film close-ups of the movie heroine's progress as the limousine bears her down the avenue.



Is This a Pipe Dream?

According to Hamilton Bell, a South American traveler, lost articles in that country are recovered by drugging a native, who wakes from his trance and travels directly to the misplaced article. So fast does he travel that other natives keep up with him by tying ropes about his body.

Tourist Cranks Himself across Stream



How the ferry raft is hauled along a cable guide by any one of three hand winches, located on the boat and on each shore

EVERY man is his own ferryman at a crossing on the upper Iowa River, near Decorah, Ia., where an ingenious raftlike ferry boat has been installed.

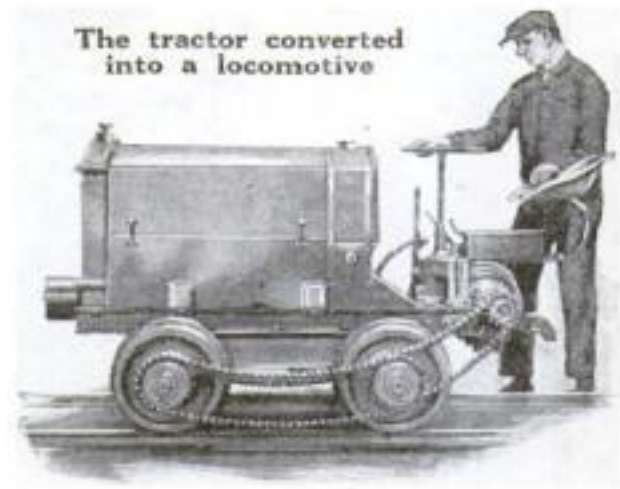
The "boat" consists of a platform constructed of timber and heavy planks, supported by four hollow steel cylinders, 30 inches in diameter and 30 feet long.

It is guided by a three-fourth-inch steel cable stretched across the river between stout posts and passing through slots in two vertical posts braced to the timbers of the platform on the upstream side of the ferry.

Whoever wishes to cross the river must turn the crank of one of three hand winches, located on the ferry and on each shore. The steel pulling cable is fastened to one of the vertical posts of the ferry platform, passes over a winch drum attached to the guide cable stake on shore, then goes back to the ferry, where it passes over a winch drum, thence to the other side of the stream, around a winch fastened to the other guide cable stake, and once more back to the ferry, where it is fastened to the other vertical post of the platform. The pulling cable may be operated from either shore or from the ferry, by turning the crank of any one of the three winches.

Endless Tread Tractor Becomes Locomotive

A SUCCESSFUL type of industrial locomotive has been developed from the "endless tread" tractor by a manufacturing concern in the Middle West. Several years ago this concern placed on the market a tractor intended for agricultural and industrial uses. It proved highly satisfactory under severe tests, hauling strings of heavily loaded trailers over rough and difficult roads. But, being of the endless tread type, it lacked speed when used in hauling loaded cars on a narrow gage track, at mines, quarries, oilfields or plantations.



The tractor converted into a locomotive

To obtain the desired speed, the tread chain was removed, flanged wheels were substituted for the sprocket wheels and other minor changes were made by which the original tractor was adapted to its use as a traction locomotive.

Gold Has Many Colors

THE color of gold by daylight appears to be a brilliant yellow, yet when the metal is beaten thin and held up to a light, the color is green. In powder form gold is ruby red; when heated, the color is purple.

Crutches on Wheels Give Patients Exercise

TO AID crippled patients to regain the use of their limbs, a crutch in the form of a light framework resting on wheels, which may be adjusted to fit the height of the patient, has very recently been invented.

Walking with the rolling crutch

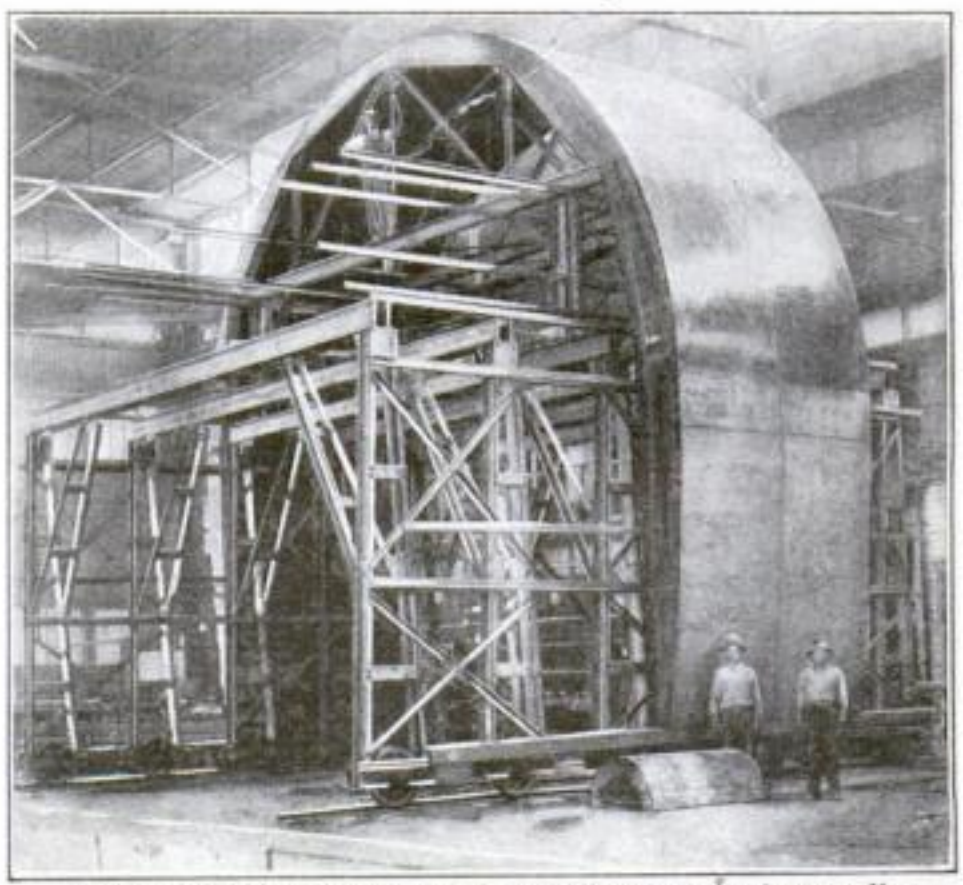
Two upholstered bars, raised to fit under the patient's armpits, support his body and enable him to exercise his legs without the risk of falling. By systematic exercise the power of the muscles is restored.

Traveling Steel Forms Build Tunnel

HUGE traveling steel forms, 32 feet or more in height and diameter, have been perfected recently to speed concrete construction work in tunnels and hydraulic projects. The frame is mounted on rollers, and moves forward on a steel traveler as the work proceeds. This steady progress keeps the concreting gang up to a predetermined schedule, as the rate of advance can be varied to suit local conditions.

The form is never dismantled during the progress of the job, as is the case with wooden concrete forms, and no changes are required after it has once been erected. The exterior surface is made smooth, with no joints which the concrete can penetrate, and, by hardening there, make further movement of the form impossible.

It is claimed that tunnels built with these new forms have a smoother interior finish and adhere more closely to engineers' specifications than those constructed by other methods of building now practised.



As the concrete work proceeds, the frame of the form rolls forward on a steel traveler

Can Levees Ever Conquer the Mississippi?

Grim Battle against Stealthy River, Waged by United States Engineers, Might Be Helped by Construction of Spillways

FIGHTING a grim battle against the stealthy, undermining attack of surging waters, engineers under the supervision of the War Department continue to construct levees along the lower Mississippi in an attempt to hold the "Great Western Sewer" within its bounds. stand the scope of the natural and constructional difficulties involved. The Mississippi River drains two thirds of the area of the United States and sluices 2,250,000 cubic feet of water a second through a natural funnel shaped bed from one to 10 miles in width. Water with a velocity of 11 feet a second and a depth of 105 feet is frequently encountered. But the volume represented by these figures is the present one. As the timber on the watersheds is removed, the moisture will be more quickly released and the river torrent increased.

The Danger "Boil"

In the photograph below may be seen a small, bubbling "sand boil" forming at the base of a levee, as the river stealthily tunnelled the bank. Later it was necessary to mattress the whole area

Guarding Rails

Extra heavy bulkheads with a topping of sand bags, braced with cross-braced timbers, protected railroad tracks near Arkansas City, Ark., during a recent flood as shown below

When a "boil" is discovered, a small levee of sand bags is thrown around it, as shown above. When the "boiling" water reaches the level of the river, pressure on the levee is removed

Meanwhile, many farmers living their alternating dry and flooded existences under the precarious banks of earth and willow insist that the levee can never be a complete solution of the problem. Levees that are high enough now will be overrun, they say, when new high water marks are reached, thus calling for continual additions to the height of the banks and increasing the extent of disaster when a break-through actually occurs.

Spillways to Supplement Levees

Because of the great difficulty in maintaining levees intact and the impossibility of predicting the limits of future high water marks, opponents of the levee system are now suggesting that it be supplemented by spillways from the Mississippi, one leading into Lake Ponchartrain to the east, which in turn empties into the Gulf of Mexico near New Orleans; another to the Atchafalaya River on the west, also emptying into the gulf. The Atchafalaya is declared to be a natural relief valve for the Mississippi.

The construction of either spillway would involve purchase of land for spillway outlets. Dikes built along the outskirts of these strips would form sluiceways into which flood waters could be dumped and sluiced through to the gulf without damage to landholders and tenants along the way.

The magnitude of the government levee work already completed along the river is astounding. During the 60 years since the work was commenced, over a billion dollars has been expended with the end not yet in sight.

Few persons outside the engineering force in charge of the project under-

Where Danger Lies

Today the crux of the situation is said to be the 200 miles above Vicksburg, created by the closing of a two-mile gap in the levee above Arkansas City, which formerly provided an outlet for 200,000 cubic feet of water a second.

The dramatic struggle between man and the mighty river is never ending. Sometimes the water gains its advantage slowly; at other times it breaks free suddenly where no break is expected. In time of rising water guards patrol the levees day and night, keeping a sharp lookout for slides and "sand boils," which are a constant menace to the completed work.

The slides usually occur on the land side of the levee and are due to thin water-soaked layers of earth. Their movement is rapid. In one instance a guard observed indications of a slide two feet back from the levee top, and while the report was being transmitted to headquarters the rift lengthened to 180 feet. It required half a million bags of sand piled around the slide to hold back the threatened overflow.

Boils are caused by water tunneling through gravel underlying the levee. Through these tunnels the water at great pressure from the high level of the river filters under the levee and reappears on the land side as extensive patches of bubbling waters. If the boils are allowed to continue unchecked, the levee sags and within a short time the water from the river surges through the weak spot thus developed. Boils are most dangerous when they appear close to the "toe" or base of the earth bank. When they crop up a thousand or more feet away, the chance of disaster is considerably lessened.

Whenever muddy water is discovered boiling up at the base of the levee, a small levee of sand bags is thrown around the boil. The water is allowed to rise to the height of the river and all pressure is removed.

Broken lines in the above map indicate proposed spillways from the Mississippi to the Gulf of Mexico by way of Lake Ponchartrain on the east and the Atchafalaya on the west

How Levees Are Built

As long as the water seeping continually through the levees remains fairly clear, there is no immediate danger.

Usually Mississippi levees are built to a height of three feet above the highest flood stage. After completion they are sodded with grass as a protection against erosion by rain. For additional strength a layer of concrete is sometimes added. During a recent flood, railroad tracks near Arkansas City, Ark., were protected by extra heavy bulkheads with a topping of sand bags braced by timbers.

Automatic "T" Signals Wind Direction to Fliers

New Ground Sign Flashes at Night

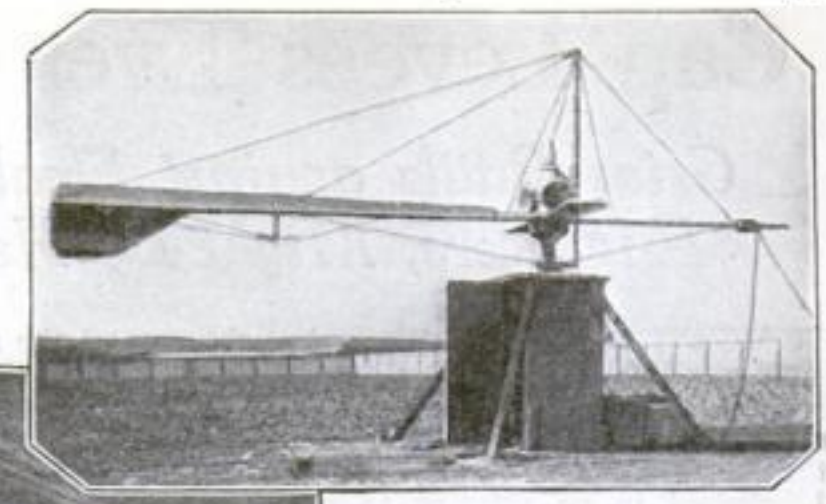
NIGHT flying planes will be aided in making landings by an automatic illuminated wind indicator and ground sign resembling a weather vane now undergoing tests at the Croydon aerodrome near London, England. The same indicator is useful for signaling aviators by day.

At present the ground sign and wind indicator in common use on landing fields consists of long wooden platforms, painted white and joined in the shape of a T, the long arm of the T indicating the direction of the wind. The use of this sign necessitates employment of a crew of men to shift the position of the T whenever the wind changes.

The new automatic device, also in the shape of a T, consists of a framework with two winged white arms, pivoted like a weather vane and with a powerful light source placed at the intersection of the arms. The long arm is 20 feet long, and the short arm 10 feet.

In operation, air currents, exerting a pressure on the long tail, swing the head of the T into the wind. A series of lenses on the four sides of the lamp house throw beams of light along the white painted arms. The light source is fed from cylinders of dissolved acetylene gas stored under the framework, and produces an illumination of 27,000 candlepower.

As a day sign, the indicator can be seen five miles away by a plane traveling at normal flying height. At night the light can be distinguished 12 miles away. Its shape can be distinguished for two or three miles.



Arms of the "T," mounted like a weather vane, as shown above, are illuminated for use as a night signal by a powerful light at the intersection of the arms. The long tail indicates wind direction

Draftsman Can Palm This Handy Ink Eraser

A SMALL clip around the middle finger and a short spiral spring enable the stenographer, draftsman or artist to palm the ink eraser while using the hand for other operations. The eraser is connected with the splitring finger clip by a spring.

The eraser is renewable. The holder, of spring steel, can be pried apart far enough to remove the stub and insert a new eraser.

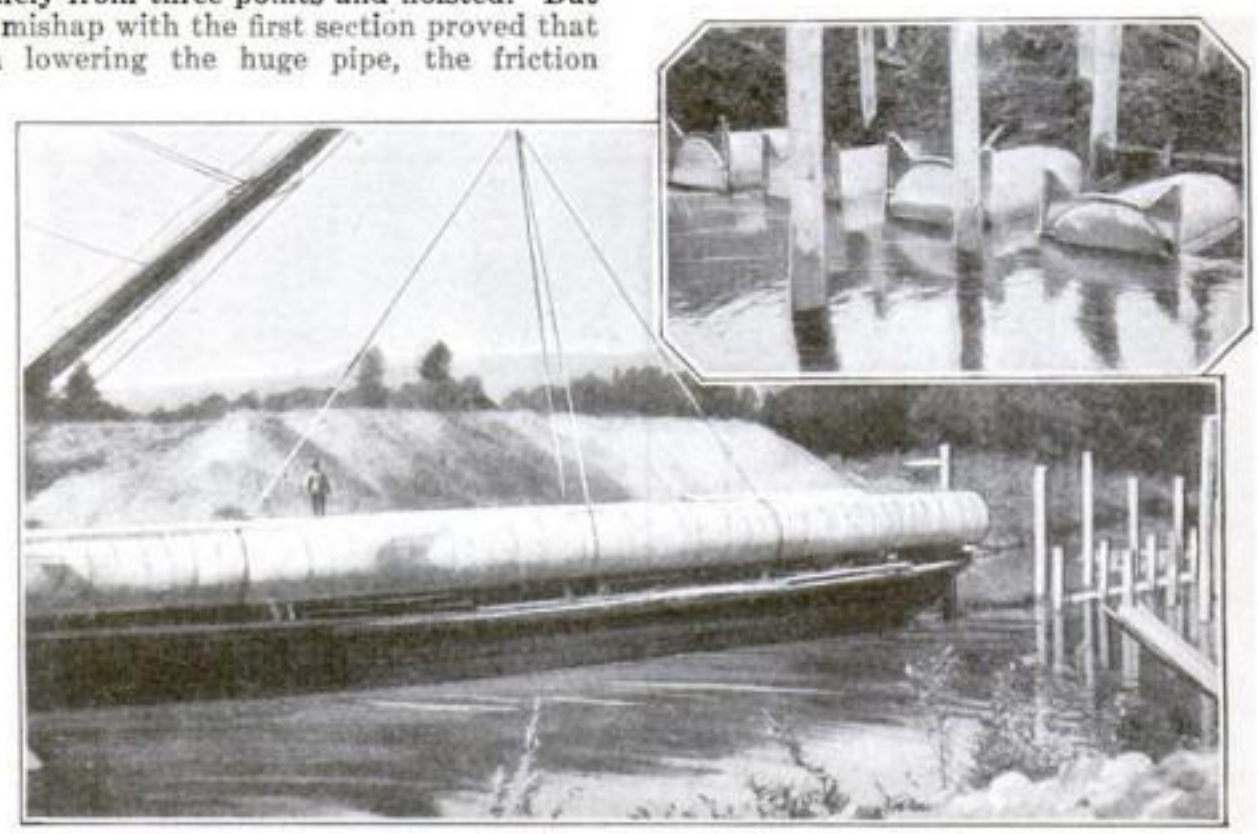
PEARL fishers in the Gulf of California estimate that one oyster shell in every thousand contains a pearl. The average pearl-fishing party, working in water about 40 feet deep, obtains about three tons of shells a day.

110-Foot Pipes Laid in Single Lengths

BULKY 110-foot lengths of six-foot corrugated iron pipe, with tide gates attached, handled by special machinery and laid in exact position with the aid of piling, have been the means of draining and reclaiming 5600 acres of Columbia River overflow land in Cowlitz County, Wash.

The weight of each culvert section alone was six tons and the self acting gate on the end weighed another ton. Tests showed that the heavy pipe could be suspended safely from three points and hoisted. But a mishap with the first section proved that in lowering the huge pipe, the friction drums of the clamshell dredge would slip. Therefore resort was had to the manipulation of the steam cocks on the cylinders of the hoist engine, using compression of the engine to control the descent. Rows of piling were constructed to hold the culverts in place while filling in with soil.

At the lower, discharging ends of the pipes tide gates were installed to permit the exit of the drainage water, but preventing the ingress of tide water during times when the pipes were submerged.



Suspended at three points, 110-foot pipe sections were lifted and lowered. Inset shows drainage culverts in place, with tide gates to prevent back flow

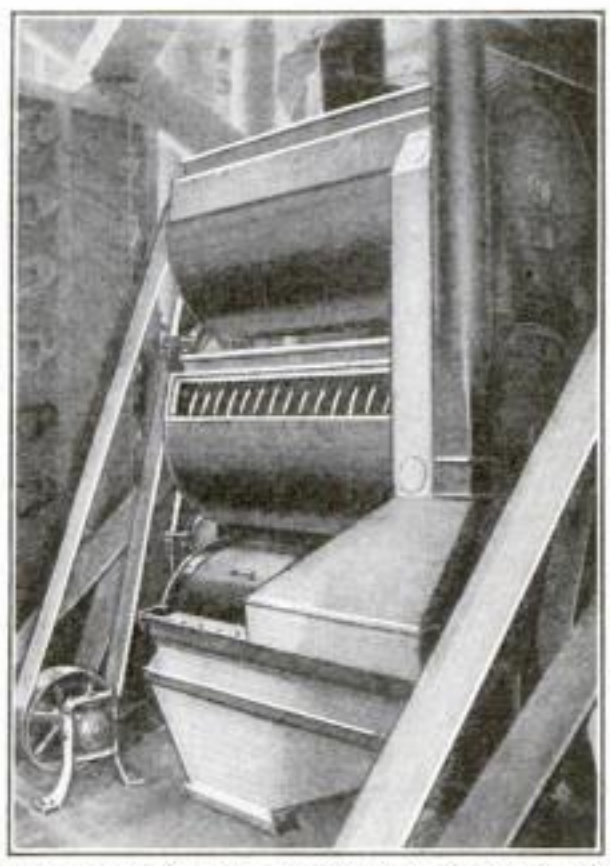
Revolving Disks Sort Weeds from Wheat in New Machine

WEED seeds that comprise from two to 18 per cent of the total bulk of wheat as it is harvested, are now successfully removed by a machine developed by the United States Department of Agriculture. These foreign seeds, made up as they are of wild oats, wild buckwheat, vetch, and kinghead, must be removed from the yield before the wheat is ground into flour.

Pockets Catch Weed Seeds

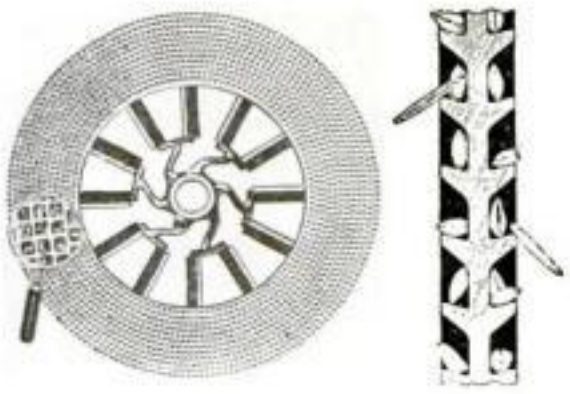
The new machine, called a "recleaner," consists of 15 aluminum disks set 2¾ inches apart on a shaft rotating at 60 revolutions a minute. Each disk is slotted with a large number of undercut pockets, that act as sorters. Three sizes of pockets are used for making the separations. The grain to be cleaned is fed into the machine near one end and the small weed seeds and dirt are picked out of the mixture by the first disk containing smaller size pockets.

As the grain progresses through the machine, the disk containing the larger size pockets pick out the wheat kernels and leave the oats, wild oats, barley, and other material longer than wheat.



This material is discharged through the opposite end of the machine.

Fan shaped blades on the inner periphery of the disks move the grains along from one disk to the other, until the grain emerges from the lower end as practically pure wheat. The gleanings are carried over and above the shaft and dropped into a small trough. In operation the fine seeds are discharged into bags on one side of the machine and the cleaned wheat into bins or wagons.



The above front and cross section views of one of the 15 sorting disks in the wheat cleaning machine (at left) show arrangement of pockets that catch the wheat kernels while excluding the longer weed seeds

In one test, grain containing up to 38 per cent of weed seed was passed into the machine, reappearing as cleaned wheat, without visible traces of foreign grains.

Crane Operator Rides with Load in Warehouse

CRANE operators in a San Francisco warehouse, ride with their loads on nall boatswain chairs suspended from the ane blocks. By being close to their work ey are able to pile the huge rolls of erchandise more quickly and neatly.

The crane is equipped with an electric nd control with four buttons for raising d lowering the crane and for forward and verse motion. The operator, seated on e crane seat with the control panel in his nd, can direct the crane and its load to y corner in the huge warehouse.

A pound jar of honey there is the contrated essence of 60,000 flowers, and to ake it the bees may travel more than 000,000 miles. One colony of bees will oduce from 60 to 80 pounds of honey in a rking season.

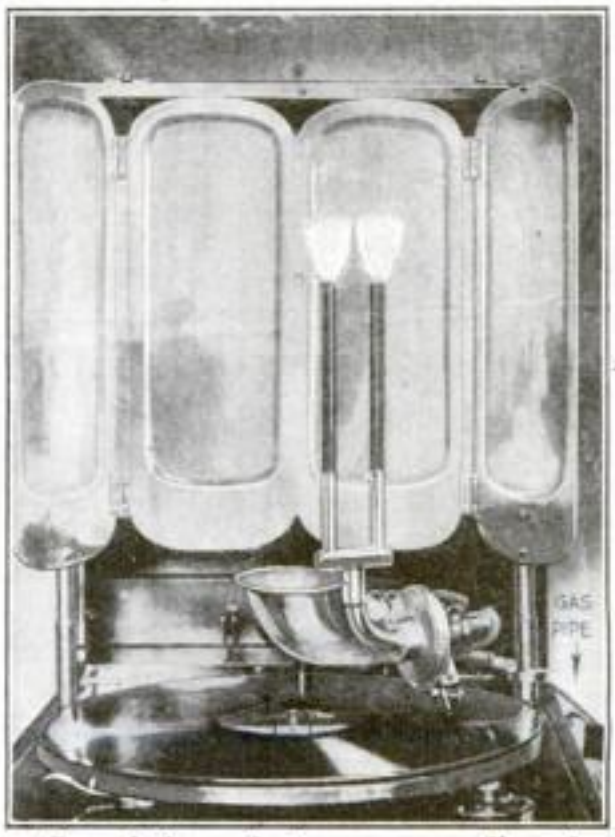
Heated Air Improves Tone of Phonograph

BASING his researches on the fact that sound waves seem to be purer and stronger when transmitted to the listener through a warm, dry atmosphere, Mr. G. Kitchen, inventor of the Kitchen rudder, has perfected a tone clarifier for phonographs.

The reproducing needle of the talking machine is connected with a diaphragm that divides the sound chamber into two parts. One side is kept filled with gas by a connection with the city mains. The other side connects with a short tone arm and horn. From the gas filled compartment a short piece of tubing leads to two gas burners, which extend upward to the center of a series of sound reflectors.

When the machine is silent, the gas burns steadily, but if the diaphragm is moved by the needle traveling in the record groove, the pressure of the gas is varied. This action affects the heat of the air above the outlet of the sound chamber, producing for each note the most satisfactory atmospheric condition for its transmission.

It is said that the machine reproduces in remarkable detail the sounds of a voice and the fine tone shadings of an orchestra.



Sounds from the tone arm, mellowed by heat from gas burners, are amplified by reflectors

Alarm Rings when Radio Detects Distress Calls

BY MEANS of a new radio receiving instrument, distress calls from ships at sea can be detected automatically.

The new signal takes the place of the famous C. Q. D. and S. O. S. calls. It consists of four dashes of one second each, repeated three times at regular intervals. When this code is received by a vessel equipped with automatic instruments, the impulses pass through a tuning coil and then to four vacuum tube amplifiers, where they are enormously magnified.

After amplification the dashes pass through an electrically operated mechanism with ratchet wheels and lever arms. The latter terminate in dash pots for the purpose of giving the correct intervals between signals. The ratchet wheels comprise the "selector" and operate after the manner of the striking mechanism of clocks. An electric bell in the circuit rings when the distress signal is properly sent and received.

When the operator on a ship supplied with the device goes off duty for the night, he switches off his regular equipment and connects the automatic receiving set with the antenna.

Uses Deadly War Gas to Kill Bad Smells

Yale Scientist Makes Remarkable Discovery that Chlorine Will Destroy Evil Odors that Cost Nation $2,200,000 Property Loss

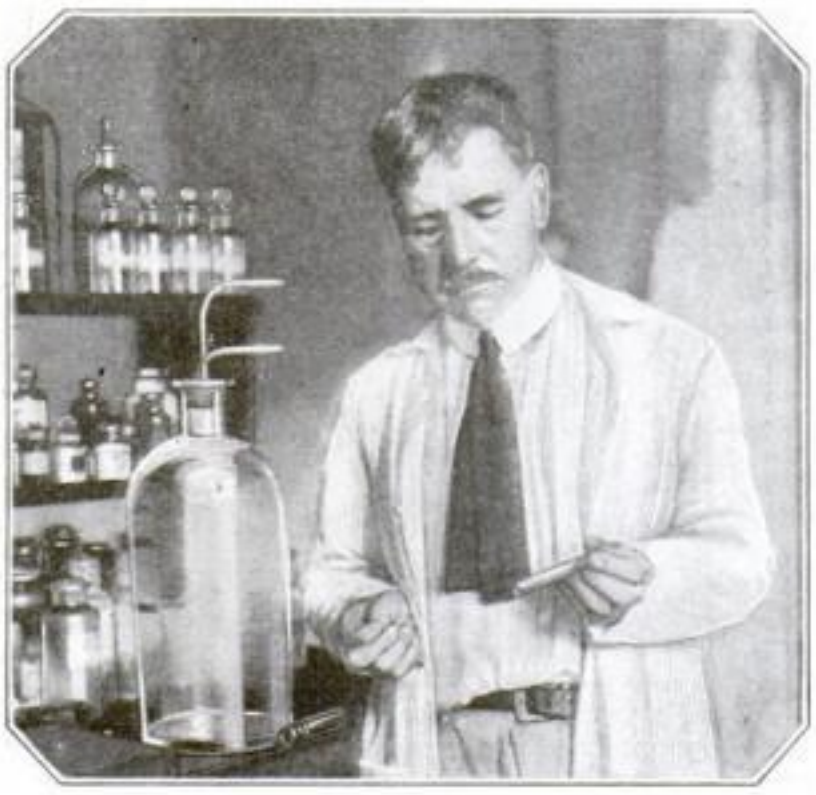
By Harry A. Mount

WE AMERICANS spend every year tens of millions of dollars for perfumes, scented cosmetics, and toilet soaps having an odor we like. But we spend many times that much to get away from odors we do *not* like. The actual property loss in the United States due to public aversion to certain odors is more than $2,200,000,000!

It now appears that this loss is almost entirely avoidable. And it is chlorine—the same greenish gas which the Germans first used in warfare—that is now coming to the peacetime rescue of hundreds of thousands of sufferers within nose range of stockyards, garbage plants, fertilizer factories, and similar industrially-necessary abominations. Chlorine, indeed, once a troublesome waste product in the manufacture of common baking soda from salt, is now finding many industrial uses. Great quantities of it are used in the textile industries for bleaching fabrics. Practically all of the white flour that goes into our daily bread has been bleached or "aged" with chlorine. And the water supplies of most of our cities are treated with chlorine to destroy harmful disease germs.

Doctor Henderson's Discovery

Now a man who has made a life study of odors, gases, and ventilation—Dr. Yandell Henderson, professor of Applied Physiology at Yale University—has lately hit on the rather remarkable discovery that chlorine gas bears a particular grudge against organic odors and, indeed, cannot exist in the same atmosphere with an odor for more than a few seconds. In that brief time a chemical reaction takes place which not only destroys the odor, but the chlorine as well. Of course, it is possible to secure an excess either of odor or chlorine, but when the two are present in balanced proportions, both disappear, and the nose can no longer detect either of them.



He Has Found a Use for the World's Worst Smell

TO ILLUSTRATE the astounding power of odors, Professor Yandell Henderson, of Yale University—who has the unique distinction of being probably America's leading expert on smells, gases and ventilation—is shown above holding in his left hand a test tube containing a small quantity of mercaptan, worse than the odor of skunks. So powerful is this innocent appearing chemical that the vapor from one drop would make the largest office building untenantable.

Professor Henderson has recently perfected a method of using mercaptan to warn city dwellers when natural illuminating gas, which is odorless, escapes from ruptured pipes or burners carelessly left open. The mercaptan is fed in small quantities into the mains, where its powerful stench mingling with the gas permeates the entire system. All traces of the odor are destroyed when the gas is properly burned, but it will cause instant detection of a gas leak, and thus prevent many a fatal explosion.

The critical problems of ventilation confronting the builders of the vehicular tunnel under the Hudson River, were submitted to Professor Henderson and his colleague, Professor Howard W. Haggard, and their recommendations were embodied in the construction now under way.

Thus, from scientific research in the neglected and seemingly unimportant realm of smells, comes a discovery of enormous economic significance, affecting millions in property values and industrial processes.

The physical nature of odors is just as mysterious as the sense by which we detect them. It would be impossible to obtain even wide agreement as to what a bad smell really is! Men of science who have been prying into the affairs of our common ancestors have discovered the scandalous fact that the smells the ape-men liked best were the very ones we kick about to the Health Department today. There are actually millions of persons sharing this old globe with you and me who would like nothing better than to be able to step out on the front porch on a warm summer morning and take a whiff of the pleasant aroma from the Chicago stockyards!

Odors Trouble Boston

I have referred to the Chicago stockyards because odorously they are the horrible example for the whole country. But there is hardly a city or town of considerable size in the United States that has not a similar problem to contend with. Even cultured old Boston has troubles of her own with odors. Says the Committee on Municipal and Metropolitan Affairs, in a recent report:

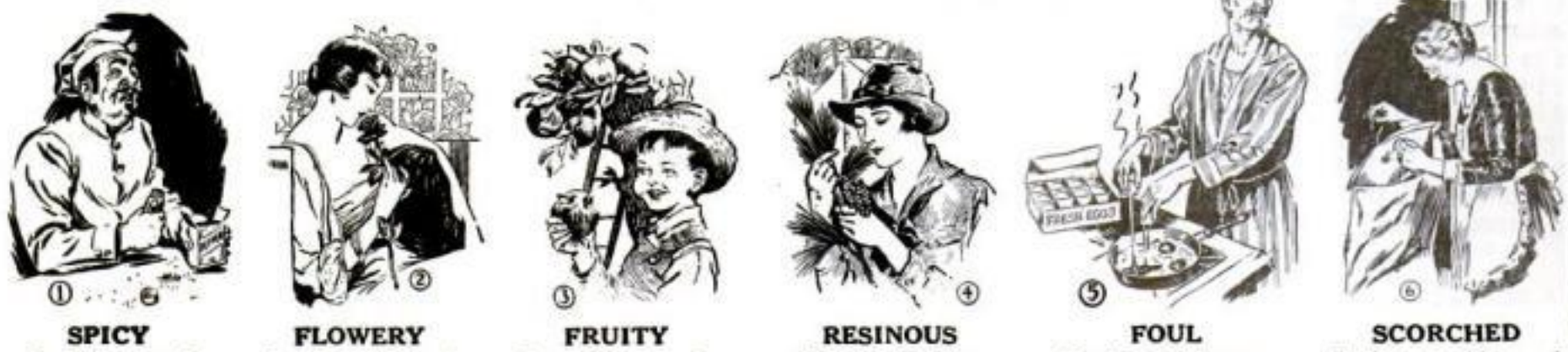
"Foul and nauseating odors have been present in Boston for many years, even before the present plant (for garbage disposal) was erected on Spectacle Island (in Boston Harbor).

"We quote below extracts from a bill of complaint filed in 1900 with Dr. Samuel H. Durgin, Chairman of the Boston Board of Health against the garbage contractors who were operating a plant at Dorchester:

> That said plant . . . has become a nuisance by reason of offensive smells and exhalations from the operations of said plant and said smells and exhalations are not only offensive, but are likewise hurtful to all persons living in the neighborhood. . . . Said smells and exhalations . . . are offensive and unhealthful and said plant and business is a nuisance.

"We thoroughly agree with the statement of Doctor Durgin recited in the above complaint and believe that the same conditions prevail today in the plant on Spectac

Science Classifies Smells into These Six Fundamental Odors



① **SPICY** — In cloves and pepper

② **FLOWERY** — In the rose and violet

③ **FRUITY** — In vinegar and fruit juices

④ **RESINOUS** — In fir and pine trees

⑤ **FOUL** — Product of decomposed particles

⑥ **SCORCHED** — In tarry and burned matter

Island, to a worse degree. Your committee is informed and believes that these odors are so strong and prevalent as to affect property values.

"These odors are noticeable over an area in which thousands of people work and live," the committee concludes, naming many points within a radius of five miles from the plant, where complaints have been raised.

The common belief that odors are unhealthful, as assumed in the foregoing, is erroneous. The latest scientific information is that the worst thing about an obnoxious odor is simply that it smells bad. If an odor is very intense, and is spread over several square miles of territory, it consists at most of but a few ounces of material! The amount that excites the sense of smell is so small as to be infinitesimal. Nevertheless, the damage to property from smell-producing plants is tangible and enormous.

Probably the man most competent to estimate this is W. J. Springborn, of New York, who believes the loss in the United States chargeable to odors totals not less than $2,200,000,000, or about $20 per capita.

Mr. Springborn has been fighting odors for many years, and has spent thousands of dollars in various attempts to get rid of them. At one time, in Cleveland, he built a big double-decked scrubbing chamber of brick, 43 feet long, 13 feet high, and eight feet wide. The odorous gases were passed twice through the entire length, in a constant spray of water, over and under 17 baffle walls in the interior. The gases were then passed into a specially constructed furnace in which natural gas was burned to consume any odors not condensed by the water spray and the baffle walls. According to Mr. Springborn, the odors eluded completely the traps he had set and the only effect of the furnace was to send the odors higher into the air, spreading them over a wider area. Later, in Chicago, Mr. Springborn put to a thorough test the idea of spraying the material from which offensive odor arises with disinfecting solutions, with results equally unsatisfactory.

The chief reason for this failure, and many others like it, is our very incomplete knowledge of the nature of odors. Ransacking every index in one of the best technical libraries in the world, I found one book describing in vivid detail the smells to be encountered in Paris, and four or five short articles describing some obscure and rather inconclusive experiments. It was then that I went to Professor Henderson—who won't object, I hope, to my calling him a world authority on smells—and from him I obtained most of the information that follows.

The sense of smell does not have its seat in the nose, but above and behind the nostrils, in a little alcove in the skull. Here is a little area of tissue about the size of a dime, covered with small, tonsil-like projections, in which the nerves of smell terminate. This sensitive tissue is called the "olfactory epithelium."

An ordinary breath does not pass directly over this membrane. But when we draw air through the nose in jerks and puffs — when we sniff, in other words— a little whirlwind is created that reaches the sensitive membrane, carrying to it the minute odorous particles that give us the sensation of smell. The lining of the nose itself is served by an entirely different set of nerves, which, when irritated, merely set us sneezing.

The sense of taste, as we ordinarily use the term, is largely dependent on the sense of smell. Do you realize that if you had lost your sense of 'ept last ıld not your morning? Something ,pens when you have ow how food loses its ıch times.

The ıe wine—or shall we oid regretful memor ıplete his satisfaction ıg, he had drawn a little ıth and exhaled it through the nostr In short, there are few tastes or flavors, with the possible exception of sugar and salt, that are not affected by the sense of smell. Our noses—and not our palates—determine the selection of most of the food we buy, the price we are willing to pay and our final enjoyment of it.

But in spite of the fact that our noses are not now as useful as they once were, our olfactory epithelium remains a marvelously sensitive organ. The amount of odorous material required to excite the nerve tips that terminate there, is so small that it cannot be weighed in the most delicate scales ever devised. Indeed, it was supposed for a long time that vibrations rather than odorous particles caused the sensation of smell. It was pointed out that a grain of musk will give off a strong odor for

You Don't Smell with Your Nose

DO YOU know why you have to "sniff the air" when trying to detect a faint odor? It is because the nerves governing the sense of smell are not located, as is generally supposed, in the nasal passages, but in an area of sensitive membrane about the size of a dime and located high above each nostril.

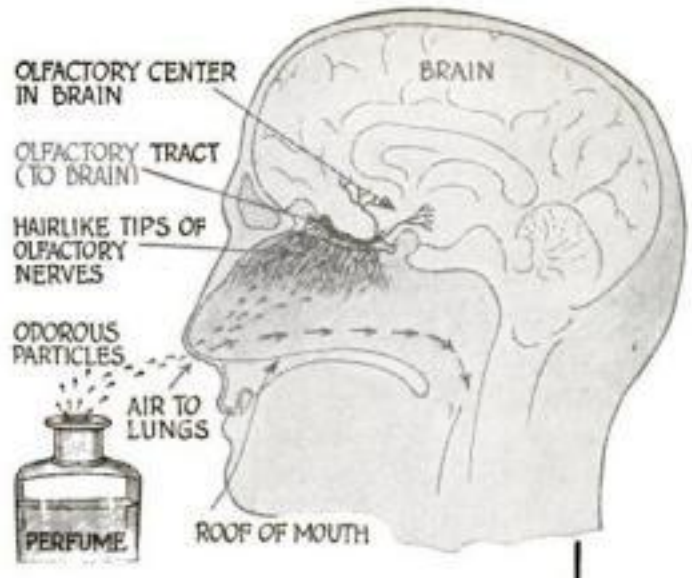
A portion of the hairlike tips of the olfactory nerves terminating in this membrane receives the sense impression and conducts it to the brain. Because of the position of this membrane outside the natural path of the breath, it is necessary to draw aside a current of air by sniffing before the exact shade of an odor can be determined.

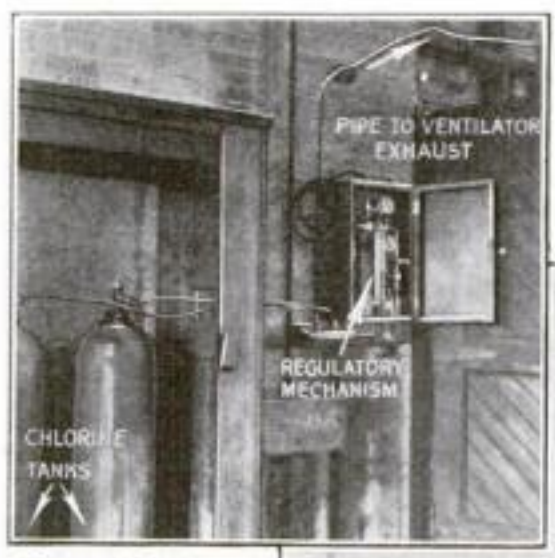
The effects of snuff and smelling salts have nothing to do with the sense of smell. They react only on the linings of the nasal passages.

So far as physiologists have been able to learn, smells are pigeonholed in the brain as visual impressions. Each smell carries associations good or bad and these associated images are brought forth by the brain when particular nerves are excited.

The reaction of the brain to an odor depends also to a large extent on the sense of taste. Only by combining the brain reports of these two senses can odors be accurately catalogued.

Degenerate as the olfactory nerve sense in man has become through evolution, it still retains the marvelous ability to detect one part of camphor in 400,000 parts of air, and one part of vanillin in 10,000,000 parts of air. As for the obnoxious smell mercaptan, the human nose can detect the presence of one part in 25 trillion parts of air.

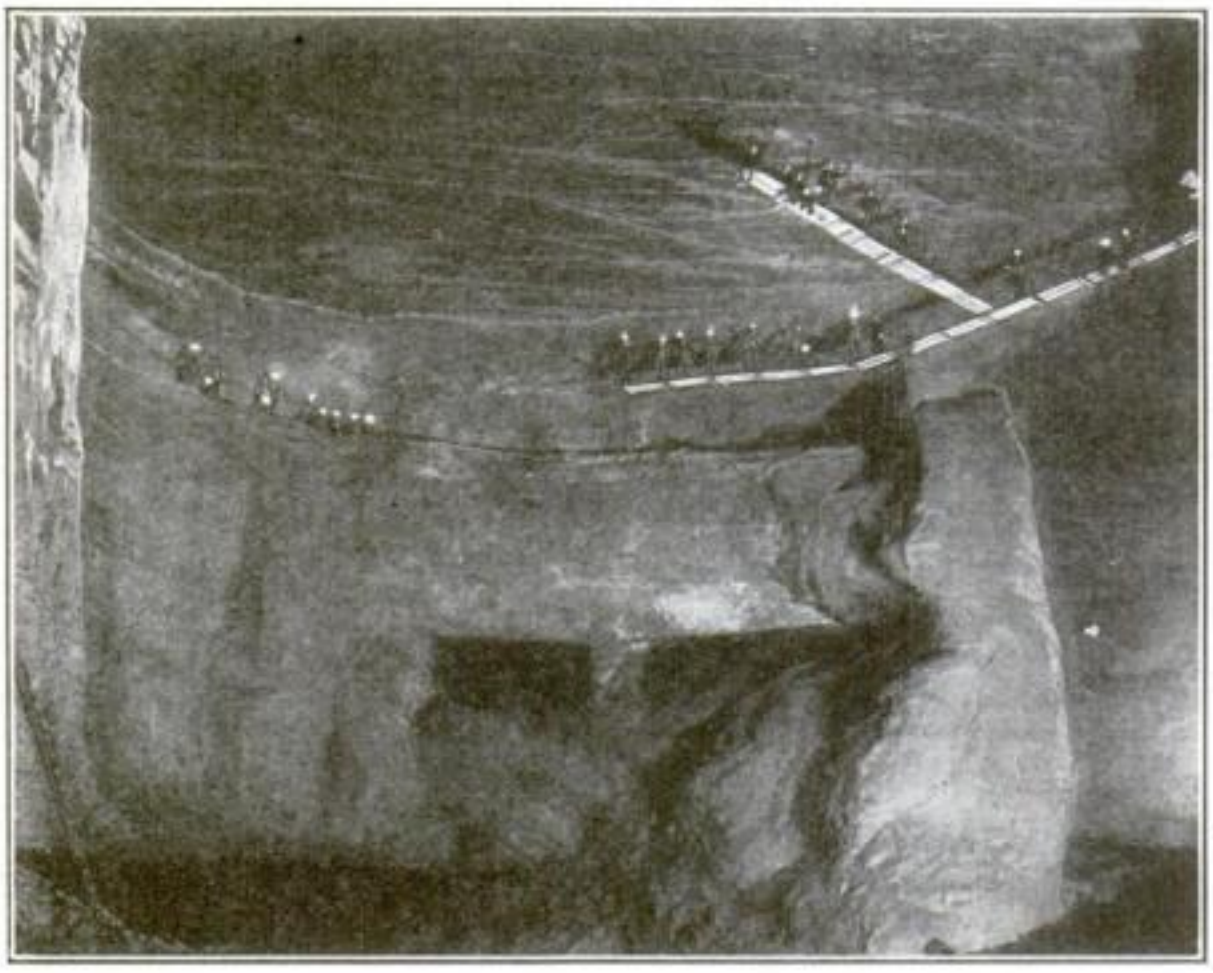


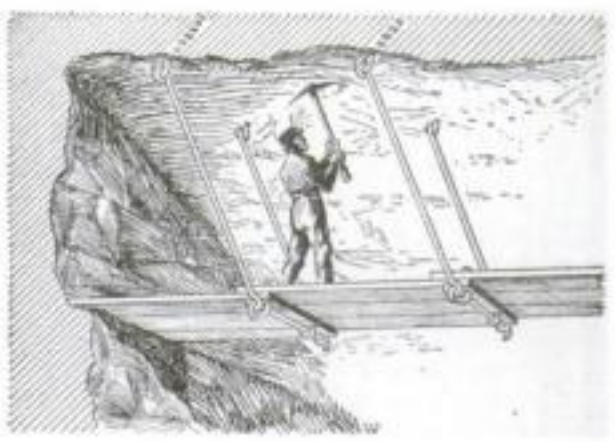


Above, the simple mechanism by which chlorine is automatically injected into ill-smelling vapors, eliminating all trace of the objectionable smell. A few cents' worth of chlorine a day will deodorize the refuse from an entire city

Formerly unbearable to near-by residents, the vapor from a garbage reduction plant at New Bedford, Mass., has been so purified by chlorine, that a man can stand directly in its path without noticing the smell

Ingenious Scaffolding Slung from Mine Roof





The peculiar construction of the plank platform which miners used when removing tons of loose rock from the 157-foot mine ceiling at the left, is explained in the sketch above

FACED with the immediate necessity of removing loose rock on the 157-foot ceiling of a mine, E. W. Campbell, of Bonneterre, Mo., devised an original system of hanging scaffolding built out in short sections from the side wall.

Standing on a shelf at one side, a crew of three men drilled holes diagonally into the top of the stope or ceiling for the eyebolts.

After the eyebolts were in place, tie rods eight feet long were hooked into the protruding eyes. The bottom ends of the rods were tied together with side rods 3½ feet long. Oak planks were laid from the shelf out to the side rods, but instead of being merely long enough to hold the tie rods vertically, longer planks were used so that the rods were pushed forward and hung at an angle. The planks were secured to the side rods by U-bolts.

years, without losing perceptibly in weight, and this seemed to prove that the odor could not be a material emanation.

But the fact is now fully established that a smell really is a material thing. And scientists at last have discovered the actual substances that cause the best known odors, and the amount of each that must be in the air before it becomes perceptible. Thus, we can smell hydrogen sulphid—the smell characteristic of bad eggs—when it mingles with the air in the tiny proportion of one part to 100,000,000! Roughly, this means that a thimbleful of hydrogen sulphid released in a six-room bungalow would render the entire place uninhabitable.

A Mental Obstacle

The secretion of a certain gland of the skunk is so powerful that a drop of it would be sufficient to malodorize the whole interior of the Woolworth Building. Realize that, and you will be ready to hurdle a mental obstacle that hitherto has prevented men from stamping out the nuisance of evil smells.

To illustrate this mental habit, think for a moment of our reaction to sound. When we hear piano music, we think not of the minute vibrations that are actuating the delicate organism of the ear, but of the vibrating strings of the instrument, or, more likely, of the nimble fingers of the musician. And so with odors; when we get a whiff of the emanations of fermenting garbage, we think not of the infinitesimally small amount of material that is stimulating the olfactory epithelium, but of the garbage pile itself. Our first impulse is to get rid of the garbage pile, and although there may be tons of the offending garbage, that is nearly always the suggested remedy.

Would it not rather seem the sensible thing to get at those few ounces of odorous emanation at the source and kill them, than to try to treat tons of material that cannot very well be got rid of? And this is what Professor Henderson has done. His attention was first drawn to the problem of odor elimination when a fertilizer manufacturer appealed to him for help in getting rid of odors that were annoying neighbors. He began a long series of experiments that finally demonstrated that chlorine gas, mixed with the odorous gases in the proper proportion, caused a chemical reaction that completely and permanently destroyed both odor and chlorine.

After some preliminary tests in a Cleveland reduction plant, which served to show the relatively small amount of chlorine needed, a working unit was installed to kill odors from a dryer in the municipal garbage reduction plant at New Bedford, Mass.

Chlorine Conquers!

In a series of extremely severe tests, not only did the chlorine completely eliminate the garbage odors, but likewise such pungent smells as come from burning feathers, hair, wool, leather and putrid fish. This plant has been so equipped now for several months, and there has been no complaint about odors. The chlorine consumption is less than eight pounds a day, costing but a few cents. Since then a number of other plants have been similarly equipped, and with equally good results.

Under the magic of modern science, a dozen or more of the olfactory plague spots in Eastern states have already disappeared, to the relief of some thousands of sensitive noses.

Vast Business Built on Sense of Smell

AMERICANS spend tens of millions of dollars annually for perfumes, cosmetics, and other scented preparations, according to figures from the United States Department of Commerce. This amount, compared with our $95,000,000 bill for coffee, indicates how substantial an economic rôle the sense of smell plays in our national life.

From the perfume industries of Europe comes every year nearly $4,000,000 worth of distilled oils to be made up into toilet preparations and sold for many times their original cost. Musk, which is the secretion found in a gland of the musk deer, costs perfume manufacturers nearly half a million dollars a year.

Since the war, America has added to her own resources by producing large quantities of synthetic perfumes made from coal tar; but most of the finer essences are still obtained from foreign countries.

None of the essential oils is attractive in itself. It is only by combining the raw, and often evil smelling, substances into blends that the perfumers obtain the rare and costly perfumes now so widely used.

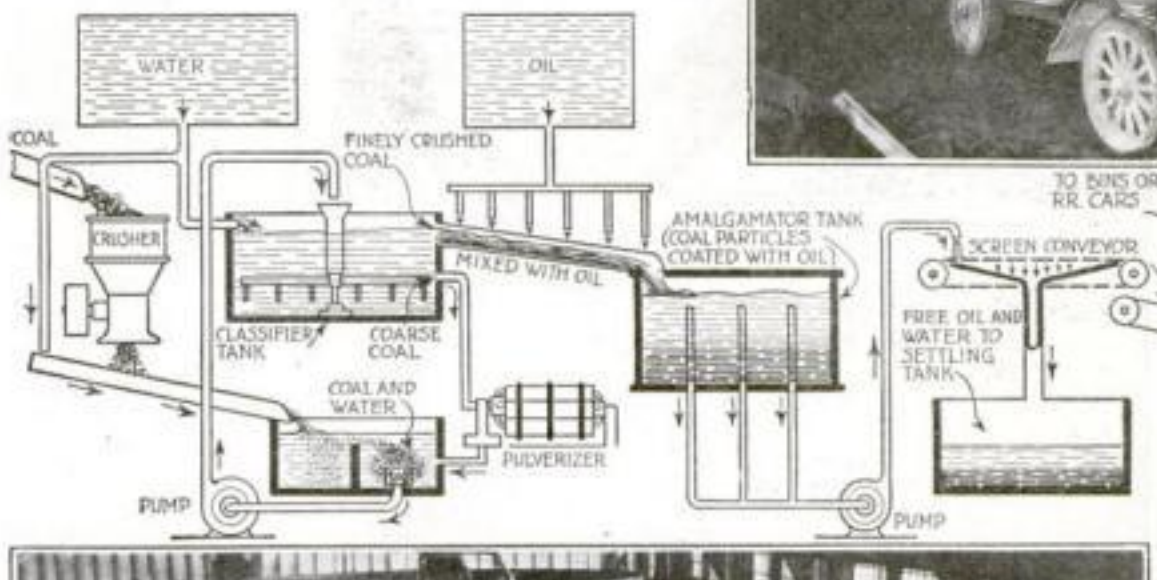
Plastic Fuel May Solve the Nation's Coal Problem

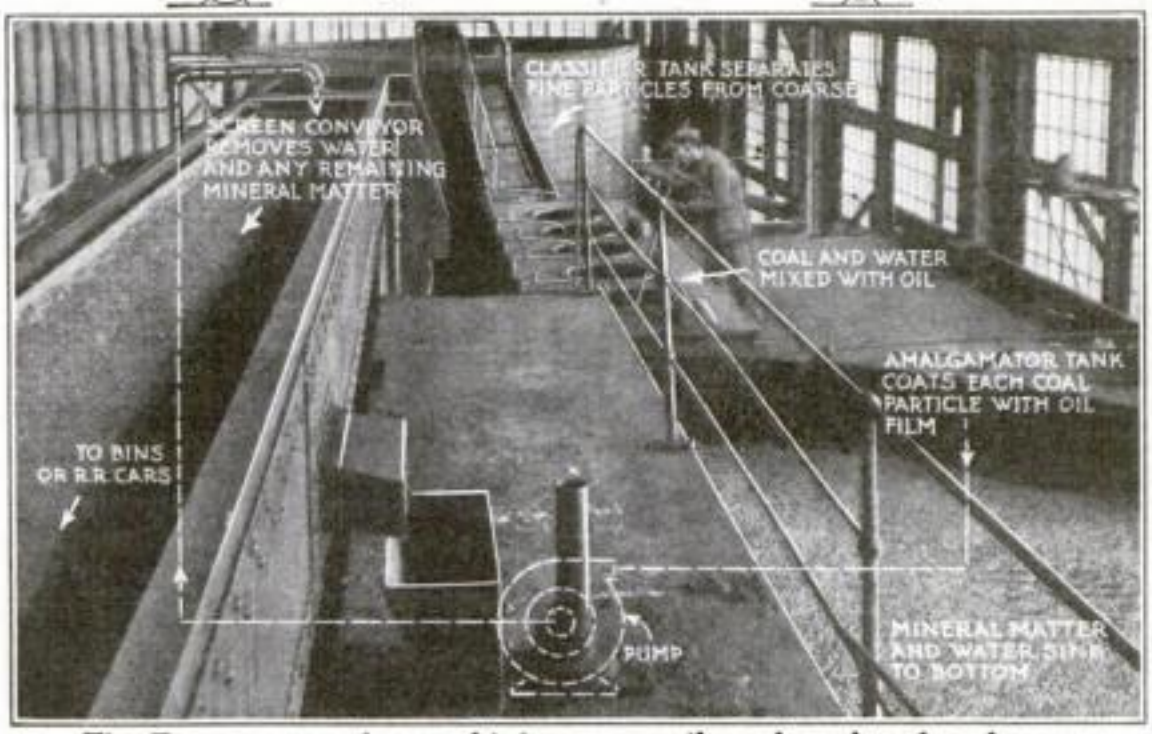
PLASTIC fuel, or "amalgam," as it is called, is now added to America's fuel resources as an intermediate form between liquid and solid fuels by the invention of a new method for combining waste petroleum oils of all sorts with waste coal to make a most satisfactory product. The inventor, Walter E. Trent, was formerly of the United States Bureau of Mines.

A plant at Alexandria, Va., is already producing many tons of the new fuel daily, and there are indications that the present fuel emergency will prove the nationwide importance of the new process. It makes available for immediate consumption, for example, the great waste piles that are seen by the mouth of every mine in every coal field, some of them representing accumulations of half a century. It has even been suggested that the treatment of municipal ash dumps is entirely feasible.

In principle, the process is simple. Wet pulverized coal suspended in water, when treated with from 30 to 40 per cent as much oil as there is coal substance present, agglomerates into a pasty plastic mass in which all the valuable coal substance and the oil join. The "ash," or mineral matter, which has been mechanically separated from the coal particles by fine grinding, does not go into the coal-oil mass, but remains suspended in the water and can be separated from the fuel paste almost perfectly. This produces an excellent fuel that is practically free from water and relatively low in ash content. In a few cases the amount of ash can be reduced below one per cent of the treated fuel.

Above, workmen are seen loading the amalgam as it drops from the conveyor





The Trent process for combining waste oils and grades of coal now considered valueless is explained in the diagram and the photograph

Accordingly, the process consists of reducing the coal to powder in a crusher and a pulverizer and then agitating the powdered coal with water and oil. The oil has an affinity for the small particles of coal and the water prefers the mineral particles, with the result that the worthless ash is eliminated in the form of a watery mud, while the finely divided coal, churned in an amalgamator, gradually forms little egg shaped granules of coal and oil. These amalgam granules are washed to remove any mineral matter that may adhere to them and are finally dried in the air. They are then found to be so solid, that they can be handled like pea coal.

Practical tests have shown that for best results the crusher should reduce coal to a size that will pass through a screen of 200 mesh to the inch. Anthracite coal is the best for the purpose; after that come bituminous and lignite.

When the large plant now building is in full operation, it is expected that thousands of tons of product will be available each day, surpassing by from 40 to 60 per cent in heating efficiency the best steam coal.

Whirling Mold Casts Fourteen Iron Pipes Every Hour

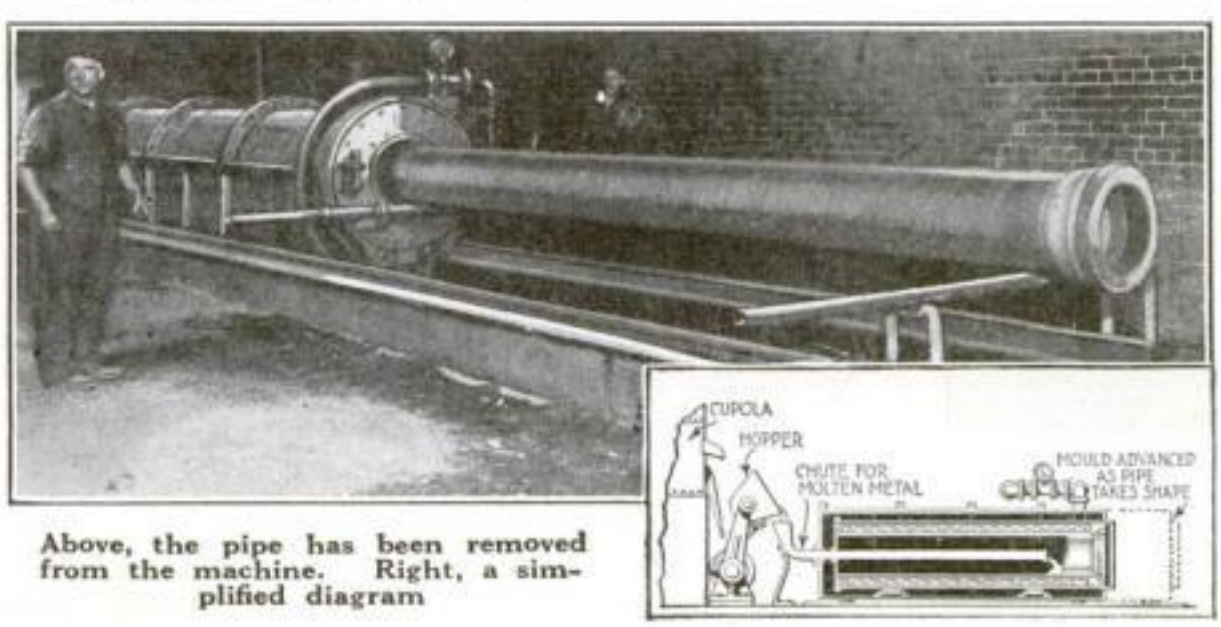
IRON pipe said to have a tensile strength twice as great as pipe made in the ordinary sand molds is now being manufactured successfully by a revolutionary French process that makes use of centrifugal force.

The pipe is formed by pouring molten metal from a hopper into a chute which leads to a rotating, water cooled mold having an inside diameter equal to the outside diameter of the desired pipe. A flare and core at one end provide for the bell and for the undercut channel which takes the lead when two sections of pipe are calked.

As the molten metal strikes the cool mold, it is distributed by the rotative force and then cooled. The mold is slowly moved away from the chute as the pipe is gradually built up to the required length. When the metal cools, the shrinkage is just sufficient so that the pipe may be removed easily from the mold.

Machine made pipe weighs less than sand mold pipe of the same dimensions and is more resistant to shocks and bending. The metal is more homogeneous and produces a clean wall inside and out with a remarkable uniformity of thickness throughout the pipe.

By this process a gang of 25 men is able to turn out 600 lengths of pipe a day with no material necessary except molten iron, while under the old system of sand casting 80 men could produce only 400 lengths in the same period, with the added cost and labor of molding and core making.



Above, the pipe has been removed from the machine. Right, a simplified diagram

Daring Airmen Locate Seals for Fur Hunters

Two of Major Cotton's seal hunting planes are shown above ready to take off from the ice

WITH his airplanes especially rigged for winter flying, Maj. F. Sidney Cotton, of Australia, is preparing for another rigorous season of reconnoitering for herds of seals off the coast of Newfoundland and Labrador and wirelessing their positions to seal hunting expeditions.

Every year thousands of seals float down to the Newfoundland coast on great blocks of ice carried along by the arctic current. Specially constructed ships sail from St. John's, Newfoundland, to find the seals and slay them for their fur and oil. Sometimes they are successful in locating the main herd, but often they have failed.

Major Cotton's method has been to fly over the arctic current and watch for the colonies of seals.

When he spots a group, the pilot gives the bearing by wireless to hunters on the mainland. The hunters set out in their sharp prowed vessels until they reach the herd. Usually the older seals escape into the water, but the baby seals are killed in huge numbers by huntsmen equipped with clubs. Besides their sealing activities, Major Cotton and his associates are official letter-carriers for the province.

The difficulties of this type of flying are tremendous. Landings must be made on ice or deep snow and the engine must be protected against freezing, since the temperature is rarely warmer than 20 degrees below zero. By means of an anti-freezing solution for the circulating system, a radiator protector, patented landing skids, and a vacuum suit for the pilot and observer, Major Cotton has been able to continue his flying under conditions that have paralyzed the main channels of communication.

The absence of airplane stores near Newfoundland makes it necessary for Major Cotton to carry on hand everything that can possibly be needed for repair and replacement. Yet in spite of all these drawbacks the success of his novel enterprise during the past year has warranted the use of two more planes during the coming sealing season.

Above, the crew of a sealing ship is seen in airplane view as they leave the vessel to slay the seals

Photos © Aerial Survey Co.

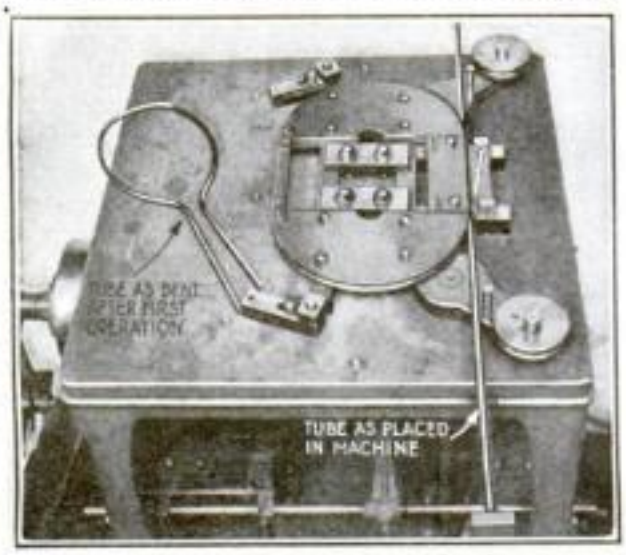
At the left are the aviators who have won a living from the frozen north with their method of seal hunting

Steel Rackets and Masks for Tennis

TENNIS rackets made of metal and wire masks that protect the eyes of spectacled players are two tennis innovations of the season.

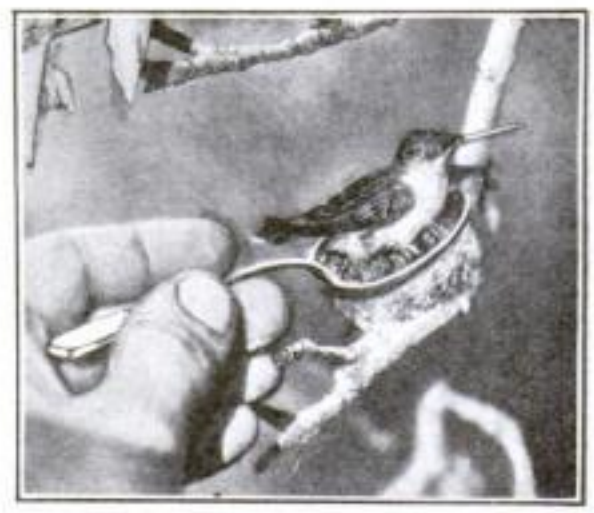
The hollow steel racket frames are bent into shape at the rate of 600 an hour by special machinery perfected by a New Jersey firm. Instead of gut, the rackets are strung with fine steel strings said to give longer life and greater resiliency.

In manufacturing the frames, the tubing is placed against a curved form, while rollers moved by an eccentric cam roll the metal around the form. The second operation consists in placing the bent forms on the same machine, but with rollers of different sizes that further curve the tubing to the correct dimensions. After other machines have woven the steel strings back and forth between the outside frames, the racket is completed by the addition of a standard handle grip.



How tubing, drawn around a form, is shaped into a tennis racket

A player wearing a protective mask and wielding a steel racket



Brood of Hummingbirds Can Nest in Spoon

BABY hummingbirds are so amazingly small that an entire brood can nestle in a teaspoon, as demonstrated by a photograph recently made by A. A. Allen, assistant professor of ornithology at Cornell University, and reproduced above. The mother bird is little longer than the bowl of the spoon.

More than 400 species of hummingbirds, among them the smallest and most beautiful birds in the world, are to be found in America. The largest of these measure 8½ inches; the smallest less than two.

Hummingbirds live on a mixed diet of insects and nectar which they obtain from flowers with their slender and extensible tongues. In destroying harmful insects they are useful to man, yet they are rapidly becoming extinct, because they are so eagerly hunted for their plumage.

Many Instruments in One Small Timepiece

The two faces of the timepiece

INCLOSING in its double faced case two watch mechanisms, a barometer, an altimeter, and a compass, a timepiece originally made for the late Charles I of Austria is said to be the smallest precision instrument in the world.

One side of the watch contains a dial with luminous figures and an alarm indicator that can be set for any hour, a barometer for predicting wind and rain, an altimeter for recording altitudes up to 9000 feet, and a compass.

On the other side is a split second dial measuring time in one fifth seconds up to 30 minutes' duration. In addition, there is a repeater gong operated by a minute pushbutton, which strikes the hours, quarter hours, and minutes.

All of these mechanisms are contained within a diameter of 2½ inches.

Flying Plane Survives Lightning Bolt

SPECULATION on the possible fate of an airplane struck by lightning while in the air has been set at rest by the experience of Capt. E. D. C. Herne, whose plane was recently hit by a bolt while halfway across the English Channel on a flight between London and Paris. The plane was unharmed and neither Captain Herne nor his mechanic suffered discomfort.

While steering his ship around the edge of a thunderstorm area, Captain Herne was startled by two blinding flashes. The edges of the wings were brilliantly outlined in green and yellow. The plane trembled and rocked for an instant, then quickly regained its balance and continued on its way.

Why Bolt Passed On

It is believed that the plane chanced to pass into the direct path of the bolt, but escaped disaster because of the lack of connection with the earth. The plane, with its content of metal, afforded a halfway stopping point for the discharge, but the flash lasted so short a time that the metal did not become heated. After spreading on the surface of the wings, the bolt again concentrated and proceeded down the trailing wireless antenna to the water beneath.

The lightning, after striking the plane and illuminating its edges, followed the radio antenna and leaped to a cloud at a lower level

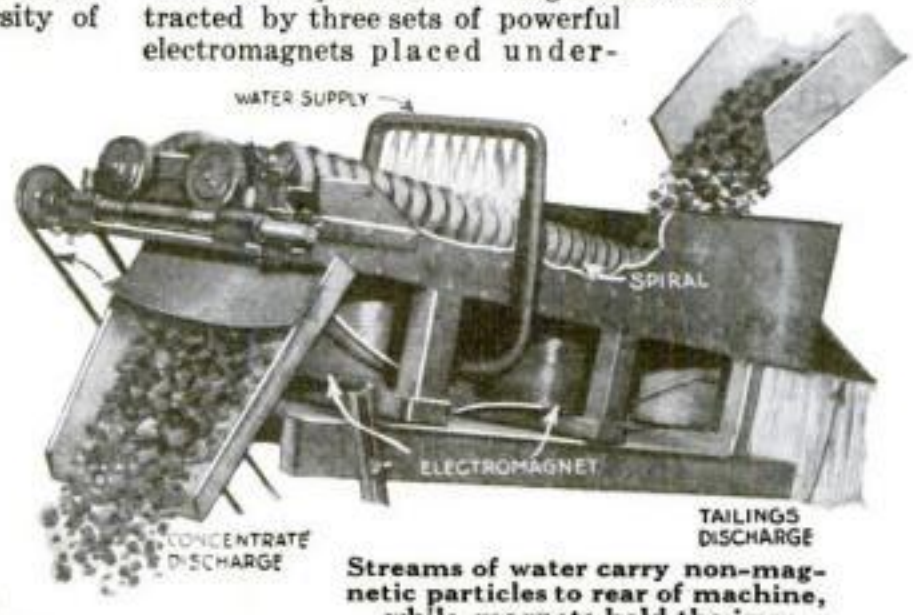
Ore Machine, Aided by Magnets, to Stretch Our Iron Supply

CONCERNED about the probable exhaustion, in perhaps 20 years, of the high grade iron ore beds of Minnesota, from which more than half the iron mined in the United States is obtained, Professor Edward W. Davis, of the University of Wisconsin, has developed an ingenious method of utilizing electromagnets to act upon low grade ore hitherto considered almost valueless.

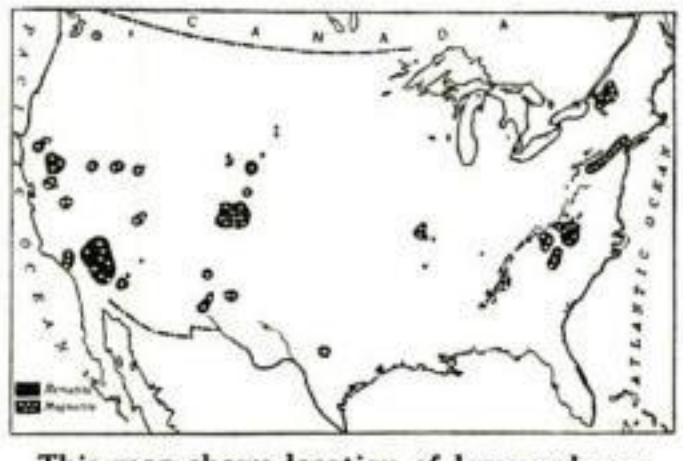
Utilizing Low Grade Ore

His device, known as the "magnetic logwasher," is expected to make profitable the mining and merchandizing of enormous deposits of low grade ore—hematite and magnetite—in the Mesaba range of Minnesota. The ore, averaging about 25 per cent iron, is run through crushers that by a series of operations automatically eliminate the non-magnetic parts of the ore. The partly concentrated ore, which consists of fragments the size of peas, is then pulverized in ball mills—large revolving cylinders containing steel balls of different sizes. These balls act like grindstones and quickly reduce the ore to a fine powder.

The final concentration is accomplished in the logwasher which, like the crushers, separators, and pulverizers, work automatically. This device consists of a long sluice box, supported in an inclined position. Through the entire length of the box runs a shaft to which spirally arranged scrapers are attached. The pulverized ore is fed into the inclined trough at the lower end, while from the opposite end is admitted a stream of water that floods the lower part of the trough, washing away toward the overflow gate the non-magnetic tailings. The small particles of magnetite are attracted by three sets of powerful electromagnets placed underneath the trough and are automatically pushed toward the higher part of the trough by the rotating scrapers, to be discharged in the form of mud-like paste through a gate provided for the purpose. This magnetite paste is fed into a machine in which the water is removed and the mass fused into a solid concentrate containing about 64 per cent of iron, which may be shipped to the furnaces.



Streams of water carry non-magnetic particles to rear of machine, while magnets hold the iron



This map shows location of low grade ore deposits made available by the "logwasher"

Hematite also Is Used

The same process may also be applied to the concentration of hematite, another low-grade iron ore, also found in Minnesota in enormous quantities. In its natural condition hematite is not magnetic, but if part of the oxygen contained in it is driven out by heating, it becomes magnetic and may then be concentrated, like magnetite ore, in the magnetic logwasher.

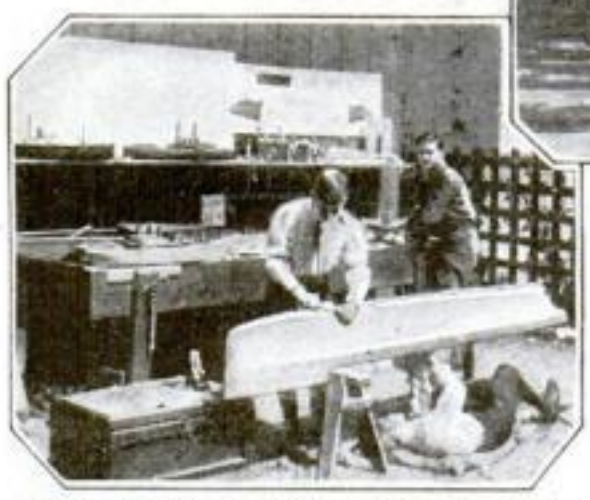
The method invented by Professor Davis has been tried for several years in an experimental plant at the University of Minnesota and later in a mill built for the purpose at Duluth. Now a plant, which will cost about $3,000,000, [illegible] near [illegible] con- [illegible] mil [illegible] abl [illegible] per [illegible] ores of Minnesota, [illegible] as one of the great iron producers, will be secure.

Boys Build Self-Propelled Model of Famous Ship

RIVALING all previous achievements in model boat building, high school students of Pasadena, Calif., have completed a 10-foot working model of the famous transport Yale, now in the coastwise passenger service. The model ship, complete to the tiniest detail, represents painstaking work and infinite patience on the part of its builders.

Every part of the model is in perfect proportion. Such details as door knobs on the hundreds of stateroom doors have been carefully imitated. Masts, funnels, and wireless antenna are correctly placed. Small electric motors turning pygmy propellers drive the little craft through the water.

When launched at Los Angeles, the model ship rode the waves with perfect balance



Boys working with simple tools duplicated graceful curves of the vessel's hull

Before commencing work on the model the exact measurements of the Yale were obtained. These measurements were scaled down to the proportionate size. The hull was built of sections of wood and the machinery placed in it. While the work was being completed, other members of the group were finishing the superstructure with all its infinite detail.

Propelling machinery consists of storage batteries and small electric motors on each propeller

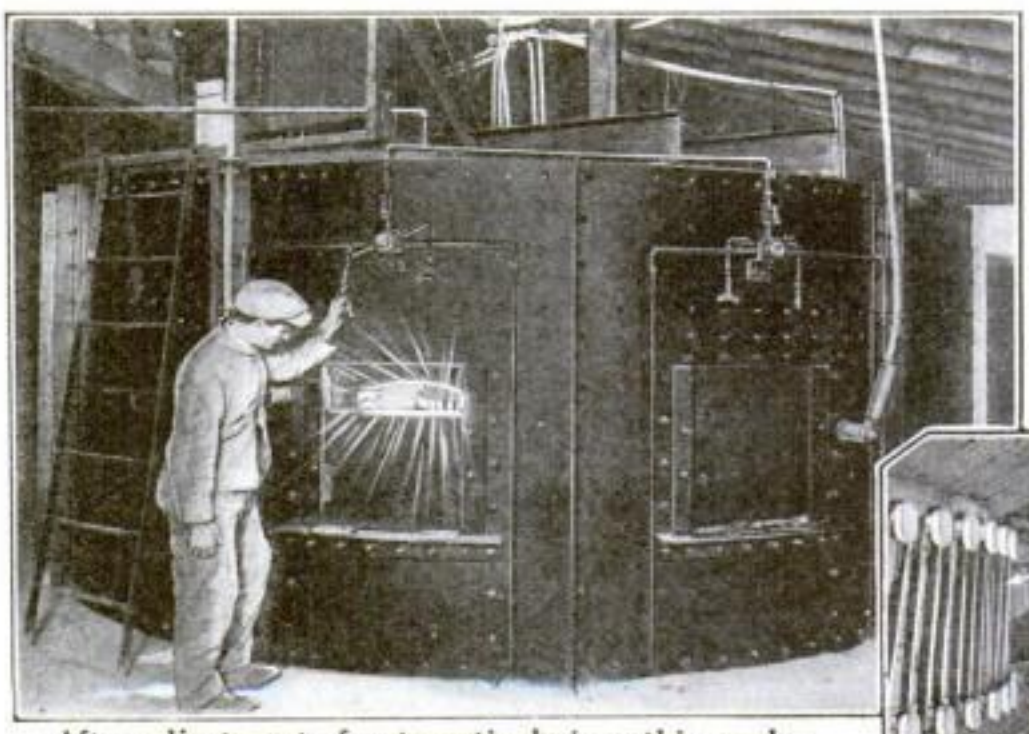
Rotary Electric Ovens Toughen Auto Parts

ROTARY electric furnaces, used to heat-treat automobile parts, have demonstrated marked advantages over oil burning furnaces because of the continuous operation and the perfect control of temperature, heating time, and rate of heating obtained through their use. The electric furnace practically eliminates scale. Material annealed requires only a brief "pickling" in acid instead of the usual three hours of soaking.

Walls in the electric furnace are of standard construction, but the hearth is made of a ring that rotates constantly during the heating period. Each furnace has two adjacent doors, one for charging and the other for discharging. A baffle plate set between the doors prevents the inrush of cold air from striking and chilling the heated pieces when the furnace is being charged. The hearth, supported on twenty roller bearings, can be rotated at any one of six different speeds.

Two sets of nickel chromium ribbon, mounted on the inner and outer walls of the frame, supply the heat. The first set is the larger and extends two thirds of the distance around the circumference. It consumes 210 kilowatts of electricity. The smaller set, designed to radiate 60 kilowatts in heat, makes up radiation losses and provides enough additional heat to bring all material out of the furnace at the same temperature.

Normally the temperature of the heating zone is held at 1580 degrees, and that of the finishing zone at 1525 degrees, but both of these heats are varied slightly, according to the material to be treated. Any temperatures between 200 and 1900° F. may be obtained. The operator of the furnace is guided by a ticket giving the number of pieces, the proper speed of rotation, and the temperature for each zone.



After adjustment of automatic devices, this revolving oven anneals auto parts without further attention. Coils of metal ribbon wound on huge spools and heated by electricity maintain the correct temperature in the ovens

Old Tires Are Quoits in Totem Pole Game

USING a symbolic totem pole as the post, and worn out tires as the rings, the city of Austin, Texas, has arranged a game of quoits that brings in revenue to the local Red Cross organization.

The pole, erected in the center of a busy thoroughfare in front of the state Capitol, is usually so well hidden by donated tires that its weird carvings are invisible. At the base of the pole an American eagle is illustrated with its claws on the spikes of a helmet and at the top is the shield of the Red Cross held tight in the claws of a lion.

Why We Grow Bald—and How Not To

New Medical Knowledge Makes Baldness a Case for Scientific Treatment Rather than Barber's Tonic

By Chester T. Stone, M.D.

BALDNESS is definitely on the increase in the United States, and is more characteristic of the American than of the European, according to recent observations by the medical profession. In the large cities of the United States is to be found a greater percentage of prematurely bald heads than in any other region on earth.

Strange as it seems, the average American business man's effort to maintain an attractive personal appearance is perhaps the most plausible reason for his developing, against his wish, this defect in appearance. The greatest proportion of baldness is found among the more fashionable of professional and business men. Men of this type make frequent visits to barbers, where the sensitive scalp and hair cells are exposed to brushes and combs that are too seldom sterilized. Infection results and the damage, usually commencing with the appearance of dandruff, has been done.

Bald-Headed Classes

Further proof that too much unscientific attention to the hair is harmful may be found in statistics revealing the frequency of baldness in various occupational groups. Among mechanics and industrial workers whose social position demands cleanliness, but whose business calling requires the performance of dirty work, are numbered almost as many bald-headed persons as in the professional group. Day laborers show a decreasing frequency, in almost direct proportion to the amount of time spent at barbers, while vagrants are very seldom bald. Daily exposure to the stimulating effects of sunlight may also be supposed to account in part for the healthier growths of hair characteristic of the latter two groups.

Baldness claims fewer women than men. Although women expose their growth of hair to the implements of hairdressing parlors, there is but little danger of contagion, because of the thickness of the growth, which prevents germs from reaching the hair roots.

In spite of cure-alls, medicinal fakes and hair restorers sold by the millions of gallons, baldness is on the increase in the large cities of the United States. Proper treatment with drugs, massages, and electrotherapy using ultra violet light rays are proving effective in many instances. But because of the fact that the baldness may be due to several combined causes, every case should be diagnosed by physicians specializing in diseases of the hair and scalp.

Many dollars spent for patented preparations on incurable cases can be saved and the treatment of curable cases made more certain of success by a knowledge of the hair and the skin in which it grows. The visible part of the hair is a shaft that develops under the surface of the skin into a root structure called the follicle. In the follicle is a sheath surrounding the hair near the surface of the skin and terminating at its lower end in a small pouch containing the hair bulb or papilla. This conical shaped bulb, embedded in the skin, is filled with a soft, delicate pulp composed of blood vessels and nerves. When a hair is forcibly extracted, some of the pulp adheres to its lower end and is erroneously supposed to be the root. If a hair is removed, its root remains and soon produces another hair by means of secretions from the bulb. As one layer of the hair shaft forms, it is pushed upward by another layer forming underneath. Microscopic glands opening into the bulb supply the growing hair with the pigment that gives it color and a lubricant that keeps it supple and firm.

Analyzing a Hair

By treating a specimen of hair chemically it can be made transparent for examination under a powerful microscope. Examination reveals three distinct layers, one within the other, and each with a distinct function. The inner tube conveys the nutritive element from the hair bulb; the middle layer transmits the coloring matter, and the outer coating is for protection. When this delicate arrangement of the hair cells is considered, it is not surprising that the careless attention given to the hair of the scalp is producing a bald-headed nation.

Baldness affects more than mere appearance. Besides being a conspicuous blemish a denuded scalp is also an indication of impaired health. Furthermore, since hair is a poor conductor of heat, it helps to maintain an even body temperature, protecting the body from chills in winter and

Do You Know These Facts about Your Hair?

IF A hair is removed from the scalp, four years are required for the hair bulb under the skin to grow another.

Normal, healthy hair is strong and elastic. It will stretch a third of its length, and will support 2 to 4 ounces.

It takes 35,000 red hairs, 105,000 brown hairs or 150,000 blond hairs to cover a scalp. The difference is caused by their relative fineness.

Grayness of the hair is caused by a hardening of the skin, which plugs the glands, preventing the secretion of the pigment that gives the hair its color. In gray hair the pigment cells have been replaced by air pockets.

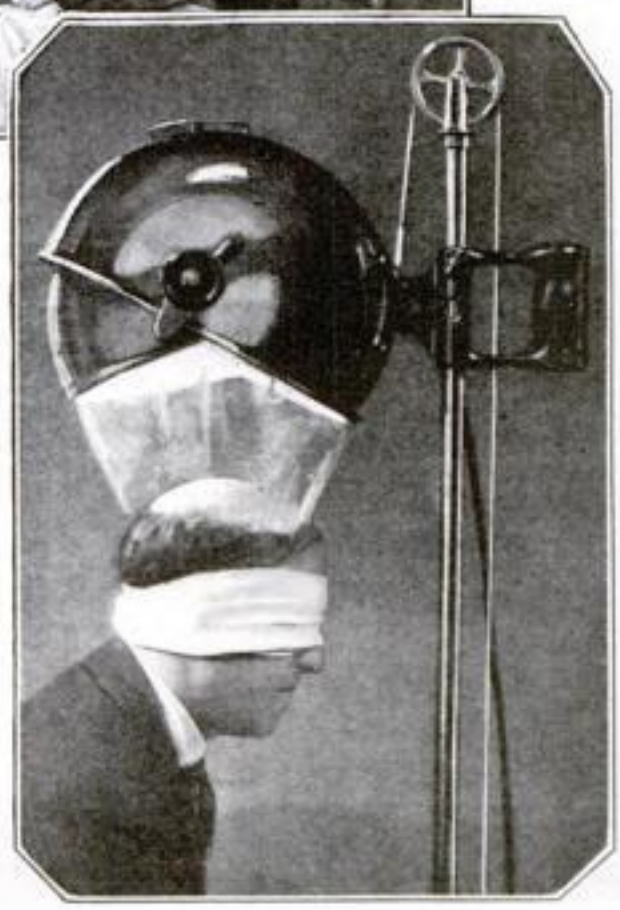
Constant sea bathing is now said to be one common cause of baldness. The salt water evaporates rapidly, leaving the hair dry and hard, and covered with a layer of deposited salt. To prevent baldness, some experts advocate thoroughly washing the hair in pure water after each plunge, and then rubbing in about a teaspoonful of olive oil.

The hair should not be washed more frequently than every two or three weeks, to remove the dirt, the dead outer skin and the excessive oil. Too frequent washing, or wetting of the hair before brushing, dries up the glands supplying the flow of oil, producing first grayness, then baldness.

Good general health is essential to the preservation of a flourishing head of hair. Worry and overwork are undoubtedly indirect causes of baldness.

Man's Chief Glory?

That man's hair can grow almost as luxuriantly as woman's is suggested by the "hair raising" achievements of the famous baseball club representing the Israelite House of David, of Benton Harbor, Michigan. In common with the other men of their sect they have boycotted the barber since boyhood



Ultra-Violet Cure

Diseases of the scalp that cause baldness are now being cured, in many cases, by rays from ultra-violet lamps of this type

excessive heat in summer.

Scientists have discovered three distinct types of baldness. The most common of these is baldness due to heredity. In this type the hair not only falls out, but it ceases to grow. Usually a study of the case shows that the male members of the family for generations have shown a tendency toward baldness in early life. Although a female in the family may not follow this tendency, instances have been recorded where the defect was passed down through the female members to male descendants.

Inherited Baldness

Inherited baldness is insidious in its development. The hair at the temples and on the crown of the head thins out slowly. Later the hair becomes sparse over the entire top of the head. Frequently, lanugo, or downy hair, flourishes for a while, but eventually the scalp becomes denuded of all growth except for the hair at the sides, which as a rule is unaffected. No sure cure has been found for this type of baldness, according to physicians who have studied many hereditary cases. The most that can be done is to delay the disappearance of the scalp covering by careful treatment of the remaining hair and attempts to further the growth of the downy hair.

Illness a Cause

A second type of baldness is caused by an affection such as typhoid fever, influenza, pneumonia, and similar maladies accompanied by high fevers. After one of these affections, the hair tends to drop out, slowly at first, then with increasing rapidity, until it can be removed in handfuls. Often during the process the scalp becomes exceedingly sensitive. This form of baldness can be distinguished by the fact that the hair drops out evenly over the entire scalp, from the sides as well as the crown. Similar effects are caused by excessive mental worry, severe fatigue, and nervous shocks from surgical operations. If treated in time, it is possible that new hair will eventually grow to replace that which has been lost.

Finally, the third variety of baldness is due to some defect in the hair-producing glands of the scalp. This is thought to be a bacterial form and probably contagious. It begins with an itching of the scalp accompanied by dandruff. Unless the trouble is arrested, the hair soon begins to thin, but usually two or three years elapse before the trouble reaches an acute stage where the hair falls out in large quantities.

Here are several distinct patterns of inherited baldness—designs handed down from generation to generation

Can Hair Tonics Cure Baldness?

THERE are three chief types of baldness.

One is inherited baldness, which follows the same pattern when handed down from father to son. Note how distinctly different are the three common patterns of this type shown above. If you are afflicted with this kind of baldness, your case is probably hopeless.

Of the other two types, one is the result of illness, such as typhoid or pneumonia. If promptly and scientifically treated, new hair can often be grown. The third type is caused by some defect in the hair-producing glands and is often contagious.

According to Drs. George M. MacKee and George C. Andrews, two prominent New York physicians, many "hair tonics" used by barbers and hairdressers may be efficacious, yet they are commonly applied improperly. Only an expert can diagnose a case and tell which type of baldness is afflicting the patient and what remedies should be used.

Useless Remedies

Numerous remedies have been adopted to arrest the loss of hair in the early stages of baldness. Usually these remedies have taken the form of scalp washes, but since any solution is devised for a particular type of baldness, its results are likely to be unsatisfactory when two or more of the types are developing simultaneously, as is often the case. Inherited baldness, of course, cannot be cured by hair restorer. Sooner or later—usually early in the thirties—the hair of a descendant of a bald-headed father will gradually drop out according to a definite pattern. There have been cases where the same pattern has been preserved with startling fidelity through many generations. Sometimes one generation will be immune; but as a rule the defect reappears again in the succeeding generation.

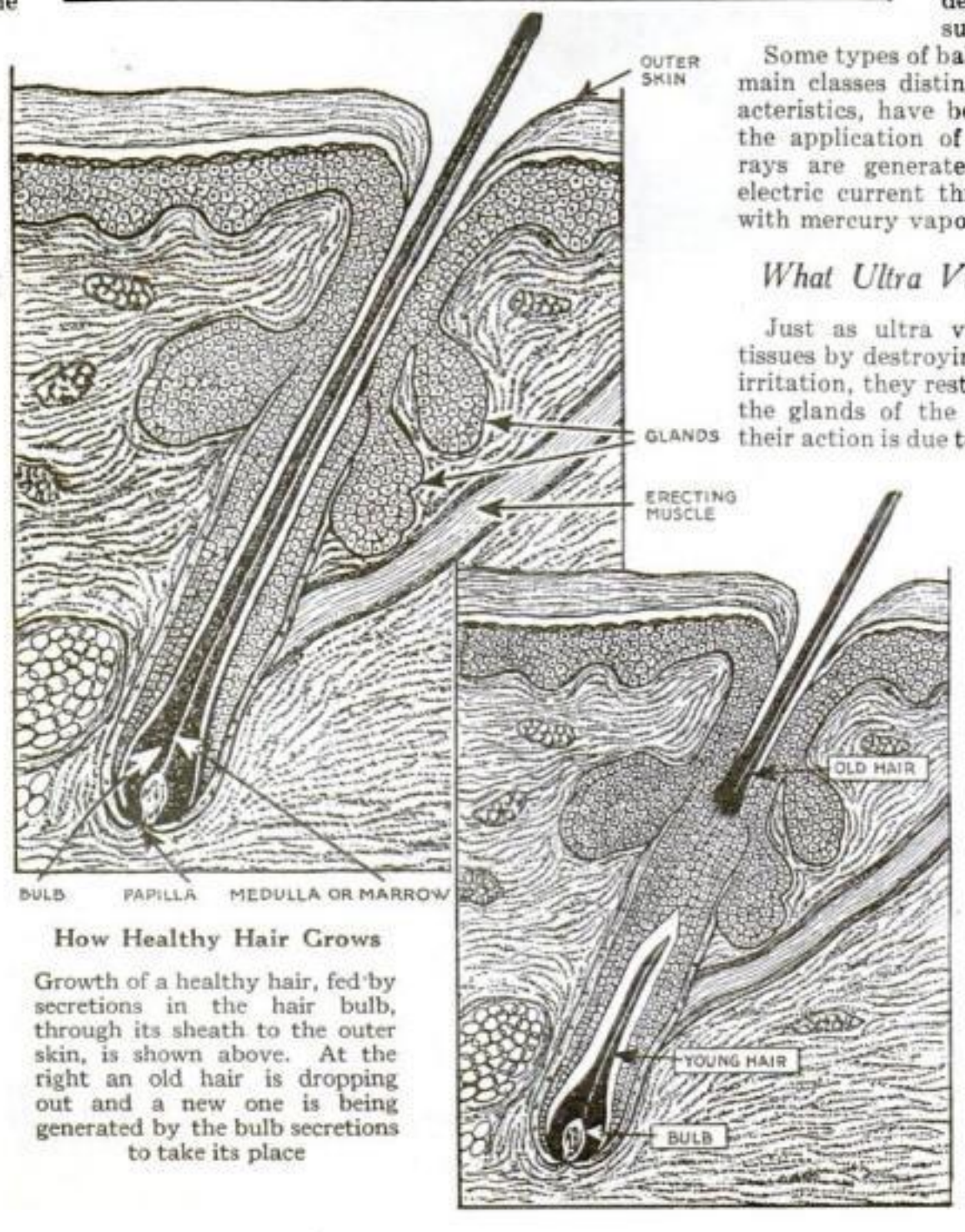
Some types of baldness, particularly the two main classes distinguished by bacterial characteristics, have been found to react well to the application of ultra violet rays. These rays are generated by the passage of an electric current through a quartz tube filled with mercury vapor.

What Ultra Violet Rays Accomplish

Just as ultra violet rays build up body tissues by destroying infections and sources of irritation, they restore the proper functions to the glands of the skin. It is believed that their action is due to the ozone generated when ultra violet light rays are passed through air containing oxygen.

When ultra violet rays are applied to the scalp, they first irritate the outer layers and dilate the blood vessels. The increased activity of the blood vessels hastens the elimination of dead tissue and the growth of new. Irritation is stopped, the germs causing the baldness are killed, and conditions are made favorable for a renewed growth of the hair papillae.

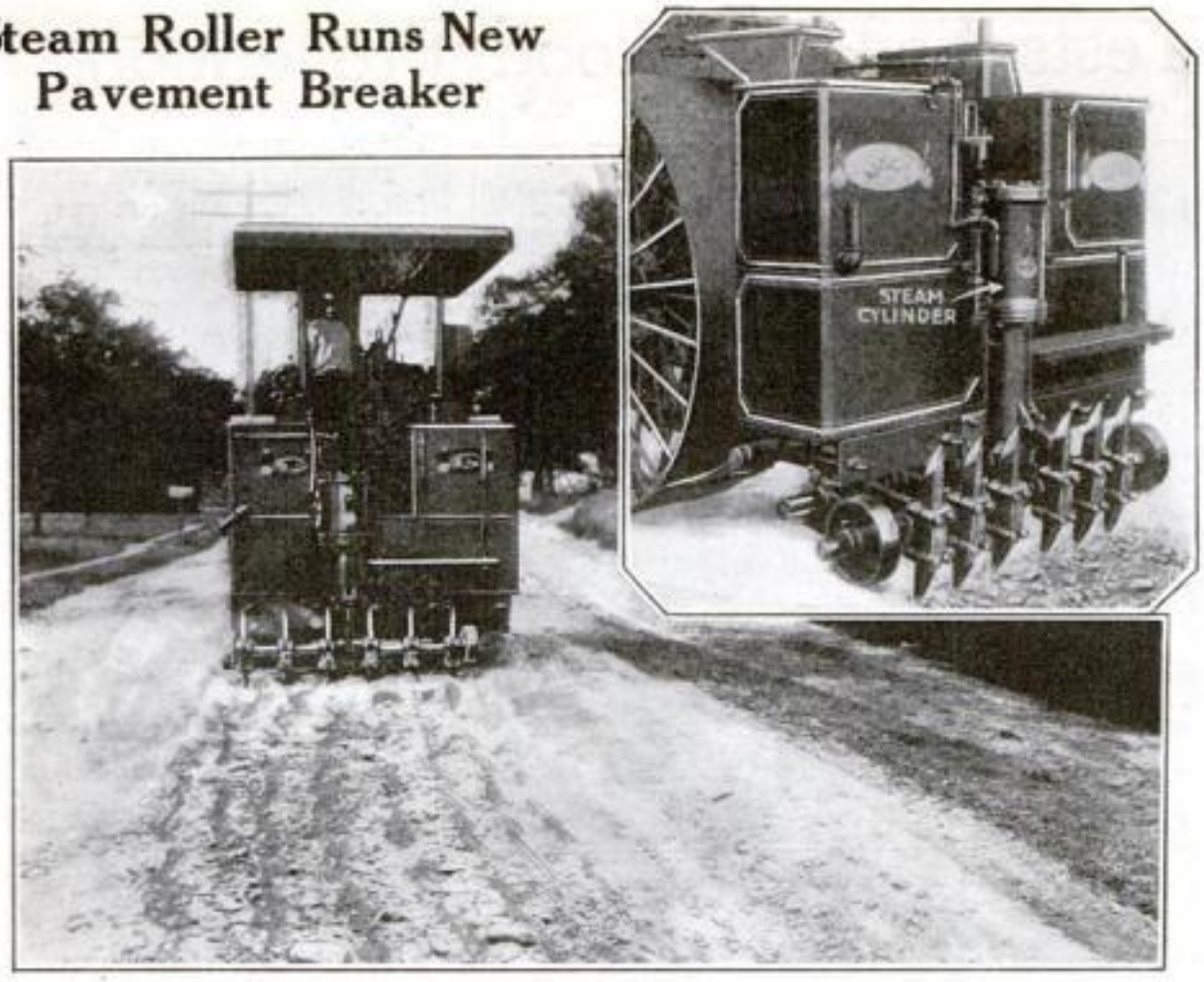
Scalps grown bald from tight hatbands can often be restored to normal condition by stimulating the nerves and blood vessels in the same way. The penetration of ultra violet rays soothes and heals the scalp.



How Healthy Hair Grows

Growth of a healthy hair, fed by secretions in the hair bulb, through its sheath to the outer skin, is shown above. At the right an old hair is dropping out and a new one is being generated by the bulb secretions to take its place

Steam Roller Runs New Pavement Breaker



A steam driven piston, exerting a force of four tons, drives the picks of the scarifier through the toughest pavement

SIX tempered teeth forced into old street paving under steam pressure comprise a new attachment, or scarifier, that can be added quickly to the rear of any road roller. The movement of the scarifier is under the control of the roller operator.

The teeth are held at the ends of arms extending from an angle iron attached to the steam roller frame. A steam cylinder placed in the center of the gang is used to raise and lower the teeth. By means of the piston of this cylinder, controlled from the cab, the picks can be forced into the surface with a four-ton pressure, or they may be lifted at will for crossing pavements and manhole covers. Gage rollers located just forward of the teeth prevent the latter from penetrating too far if the rear wheels of the roller happen to drop into a depression.

Both the length of the teeth and their spacing can be quickly adjusted by means of the clamps. By setting the picks at their maximum spacing, a cut of 56 inches can be made.

Map Tacks Keep Tabs on Fire Apparatus

CLOSE tabs on the movements of fire apparatus in Boston is maintained by a comprehensive system of map tacks and cards located at the fire headquarters. By means of the map it is possible at all times to exactly locate fire fighting apparatus, whether it is in action or laid up for repairs.

Each fire company of the city is represented by a pin from which dangles the number of the apparatus. When an alarm comes in, the operator takes from a file the card representing the alarm box. On the card are the numbers of all companies that are slated to respond to that particular call. The operator notes the numbers and removes the tags from the respective hooks to the board at the right. If a second alarm is turned in, he adds the tags on the row below.

To make possible the use of both hands in moving the tags, the card representing the alarm box is gripped between the jaws of a paper clip.

In large cities, particularly during big fires, often an alarm comes in for a fire company that is at the scene of another fire. When this occurs, the operator inspects the map and selects apparatus that is nearest and best fitted for the work and despatches it to answer the alarm.

When an alarm comes in, the tags are removed from the map to the board at the right

Three-Ply Metal Formed by Electrolysis

JUST as the strength of wood is increased by combining several thin layers or plies, sheet metal can be reinforced by forcing together two or more layers of different metals.

A new method is by electrodeposition of copper on mild steel. The steel is first perforated and then thoroughly cleaned for the plating process. After a certain period in the bath, the copper deposits on the sides become connected by the deposits through the perforations. The final product is then placed in a mill and rolled to thickness.

Three-ply metals formed in this way are used in making containers where additional strength is essential without an increase in thickness of the walls. Lead covered steel plates have also been made by this method, although with these two metals more exact work is required to insure a perfect union between the surfaces.

Blast Furnaces Burn Stumps from Logged-Off Land

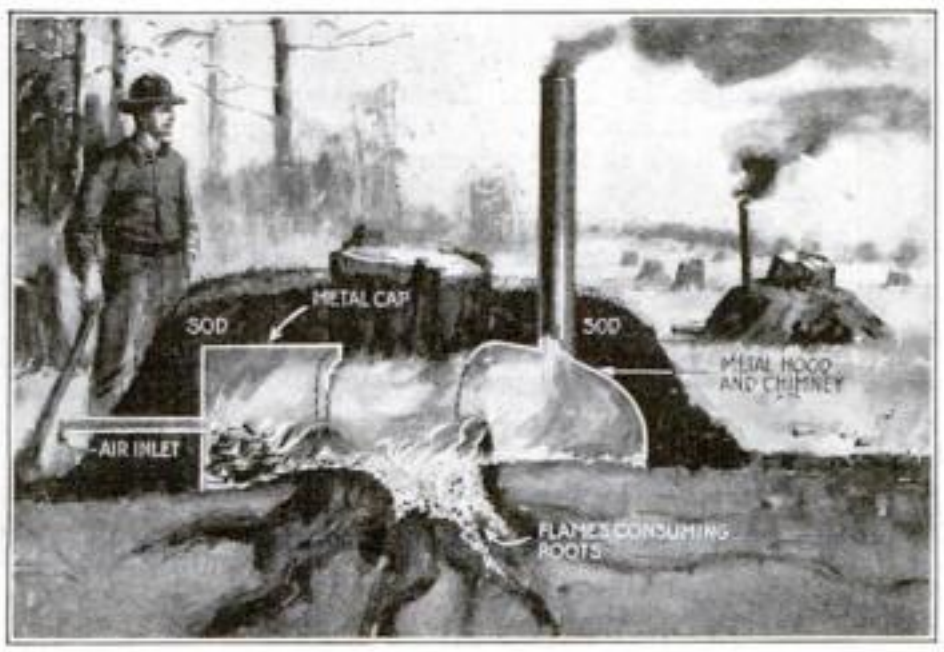
ECONOMIC clearing of logged-off land is made possible by an improved stump-burning process, which has recently been thoroughly tested by the Oregon Agricultural College. The new system is expected to add many thousands of acres to America's farm lands.

A small furnace or stove, open at one end, is placed against the stump and a fire kindled. Then the furnace and stump, with the exception of a small space opposite the stove, are banked in with sod. Draft is supplied through a two-inch pipe embedded in the sod, thus forming a blast furnace against the stump.

The flames eat directly through the stump, after which another hood is placed over the outlet and banked with sod. The stovepipe is removed, and the furnace is taken out entirely. The sod now forms an airtight stove and the stump burns without further attention, except the occasional sodding of apertures in the walls.

By this method, a large stump can be burned through in from 24 to 30 hours, and in 40 hours more the portion of the stump above ground is entirely consumed. The fire feeds itself, the stump gradually sinking into the crater and being devoured by the flames.

Results of the tests indicate that with many fires burning, large tracts may be cleared in a comparatively few hours.



Banked with sod, the furnace around the stump is supplied with draft through a two-inch pipe embedded in the sod

Sprinkling Can Tests Soil for Flood Prevention

SPRINKLING experiments, in which rainfall effects are artificially produced from ordinary garden sprinkling cans, may be used to determine data on flood run-off and soil absorption. Such investigations, instituted by flood prevention engineers, have been found to give highly satisfactory results.

The experiments were carried out on isolated plats, five feet square, surrounded by sheet iron boundaries, which extended 20 inches below the surface and four inches above it. The soil within the plats was in no wise disturbed. These plats, which communicated by means of drainpipes with galvanized iron tanks, four feet deep and 18 inches in diameter, were located on level ground and on hillsides, so as to determine the effect of level, slope, and nature of the soil upon absorption and run-off.

As the sprinkling can produces "rainfall" on each five foot plat, an observer measures flood run-off in the drain tank

In producing artificial rainfall, the sprinkling can was filled with a measured volume of water that was evenly distributed over a plat within a specified time. Duration of the "rainfall" and the volume of water precipitated were carefully recorded, as well as the exact time of the beginning and the ending of the surface run-off into the drain tank and the volume of water collected in the tank.

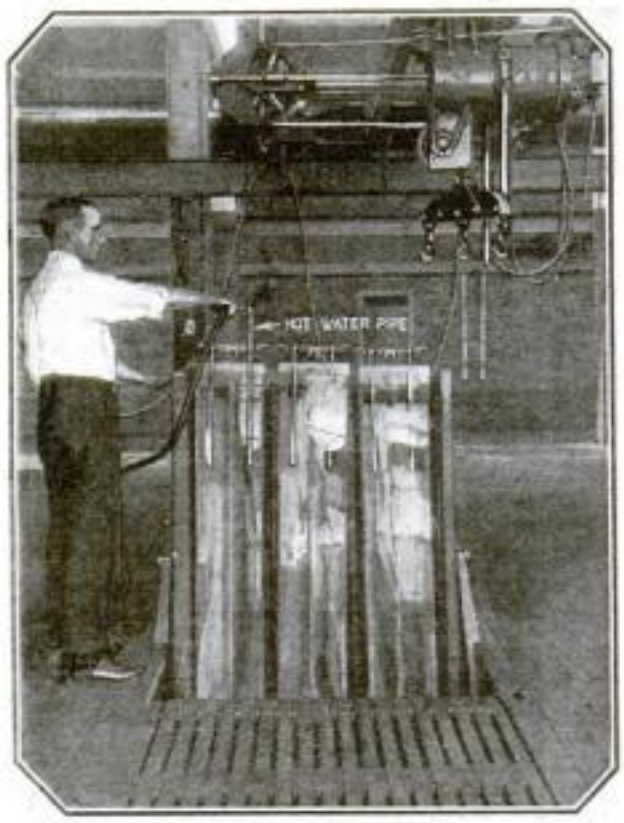
It was found that the rain absorption by loose loamy soil is much greater than that by heavy clay soil and that cultivated soil and sodded ground absorb water more readily than hard and uncultivated soil containing comparatively little organic matter. The slope of the ground was found to have little influence on flood run-off.

Lifters Frozen into Heavy Cakes of Ice

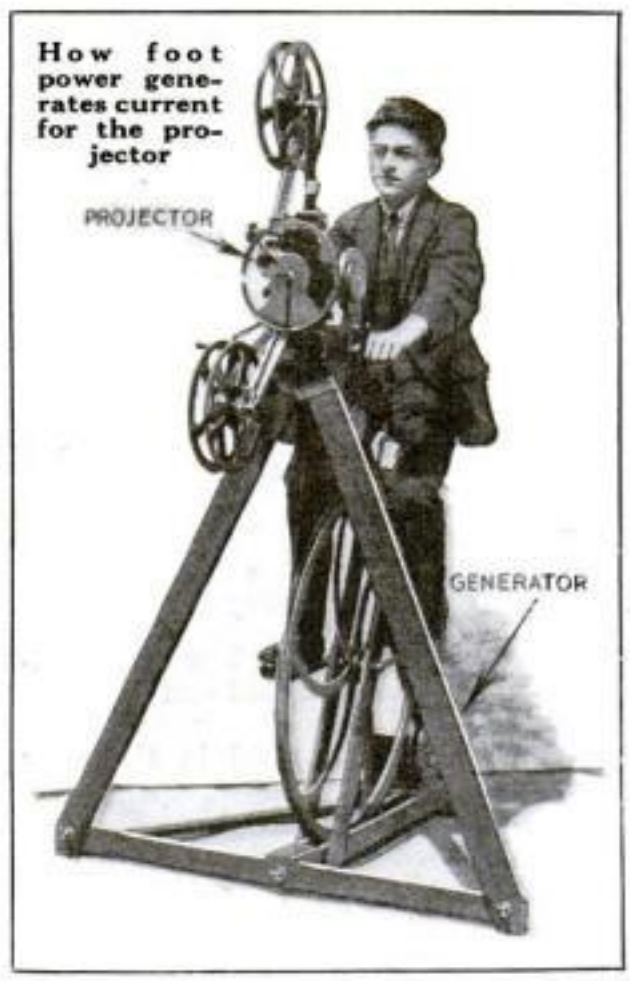
FREEZING special lifters into cakes of ice becomes economical where 1140 400-pound cakes must be lifted every day, as has been discovered in an ice plant at Cleveland, Ohio.

Instead of lifting the heavy cans in which the ice is frozen, iron lifts are lowered into the water before the freezing begins, and when the cakes are solidified 48 hours later, special pneumatic lifts haul out three cakes at a time. The lifters are made of hollow pipes, so a workman can loosen them later by connecting a hose with a double nozzle that circulates warm water through them, in that way thawing the incasing ice.

Since the cans need not be moved, the freezing process is expedited by attaching a permanent fresh water inlet to each can, and connecting an outlet with the center of the bottom for the purpose of drawing off the impurities in the water, which collect in the heart of the cake as freezing progresses. If it were necessary, ice almost free from germ and sediment could be frozen from dirty water.



Hot water loosens the lifters, made of hollow pipe, from the ice



Operator Pedals Movie Machine like Bicycle

A MOTION picture projector, for which the operator generates his own electric current by pedaling a large wheel as if he were riding a bicycle, has recently been invented in France for use where no current is available. A belt from the same wheel leads to the projector and cranks the film.

Thanks to a highly efficient electric lamp with a concentrated filament and a specially designed dynamo, the amount of power needed is comparatively small. A picture approximately four or five feet can be projected with about the amount of energy required to pedal a bicycle up a moderately steep hill.

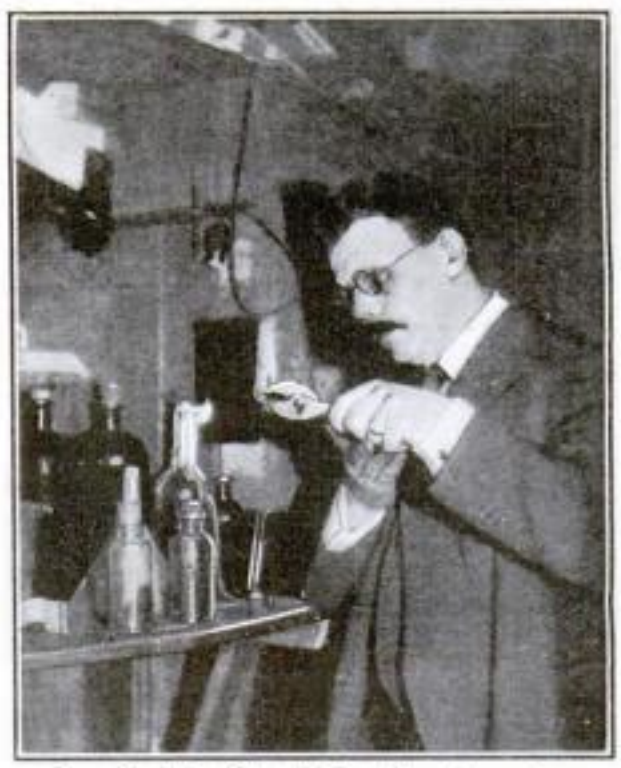
The apparatus is intended for untrained operators. It can be folded and is light enough to be carried readily from place to place for the purpose of illustrating lectures or for carrying on educational campaigns for the farmer in out-of-the-way parts of the country.

Solidified Kerosene "Ice" New Form of Fuel

SOLIDIFIED kerosene, which can be carried in the pocket or transformed into liquid and burned in a lamp after mixing it with water, is a discovery of Dr. O. F. Reinhold, of Maplewood, N. J., for which remarkable utility is claimed.

The new form of fuel looks like petroleum jelly. It gives as much heat or light as liquid kerosene, and because of its compact, portable, solid form, it contains one third more heat units to the gallon. Unlike liquid kerosene, the new product requires neither wick nor mechanical contrivance to effect combustion. Kerosene cannot be ignited with a match, but you can set fire to Dr. Reinhold's product with a match, and it will burn like a stick of wood or "solidified alcohol."

The jelly burns steadily at an even heat until consumed, leaving an oily residue which the inventor claims can be used as a lubricant. When mixed with water, the jelly can still be ignited by a match, and the same oily residue appears.



Dr. O. F. Reinhold, the inventor, burning a piece of solidified kerosene

Another advantage is the fact that the new substance eliminates the danger of kerosene explosions.

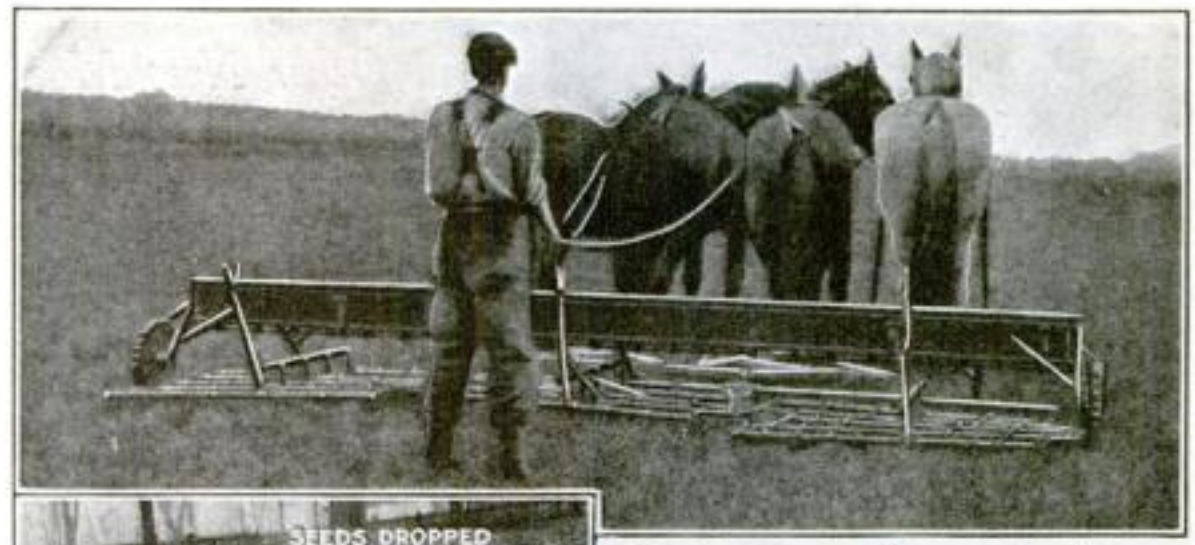
Steeplejack Fells Tree from Top Downward

WHEN a tall eucalyptus tree at Rose Hill, Calif., began to split at the intersection of its two branches, threatening to fall on houses near by, a steeplejack felled the tree in 10-foot lengths, from the top downward.

The steeplejack first climbed to the top of one trunk, which he braced with three sets of guys. Then he began to cut the tree down from the top in sections, catching each section with a rope as it started to fall, and lowering it to the ground. The job took nearly a week.

Starting at the top, the tree was cut down in 10-foot lengths

Harrow and Seeder in One Machine



Seeds are dropped from a long hopper immediately above the harrows

WITH a combination harrow and seeder now ready for use, the farmer can speed up the springtime work of planting large areas to grain and obtain an evener "catch." The new machine consists of a boxlike girder or hopper which contains the seeds and to which the harrows are attached. Either one, two, or three harrow sections may be used with the seeder.

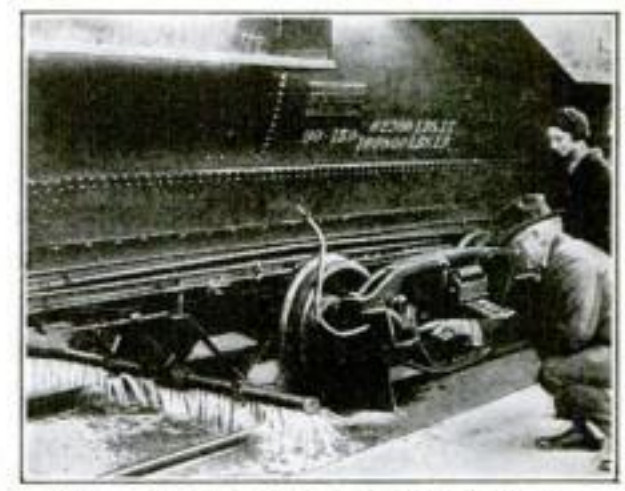
Because the seeds are released from a point only 11 inches above the ground, the makers of this machine claim that the usual unevenness of seeding due to the wind is entirely eliminated. In addition, the new method is said to reduce waste of seed to a minimum.

DUST from the Sahara Desert, blown thousands of miles by wind, is reported to have settled thickly on the decks of the Dutch steamer Yildum when 250 miles off the coast of the United States.

Locomotive Sprinkler Lays Dust on Railway

TRAVELING over the dry desert country of western Colorado is pleasanter for tourists since Superintendent W. H. Whalen of the Southern Pacific Railway devised an automatic track watering system that lays the dust beside the railroad right of way.

The sprinkler consists of a perforated pipe attached crosswise of the track beneath the tender of the locomotive and fed from the engine's water tank.



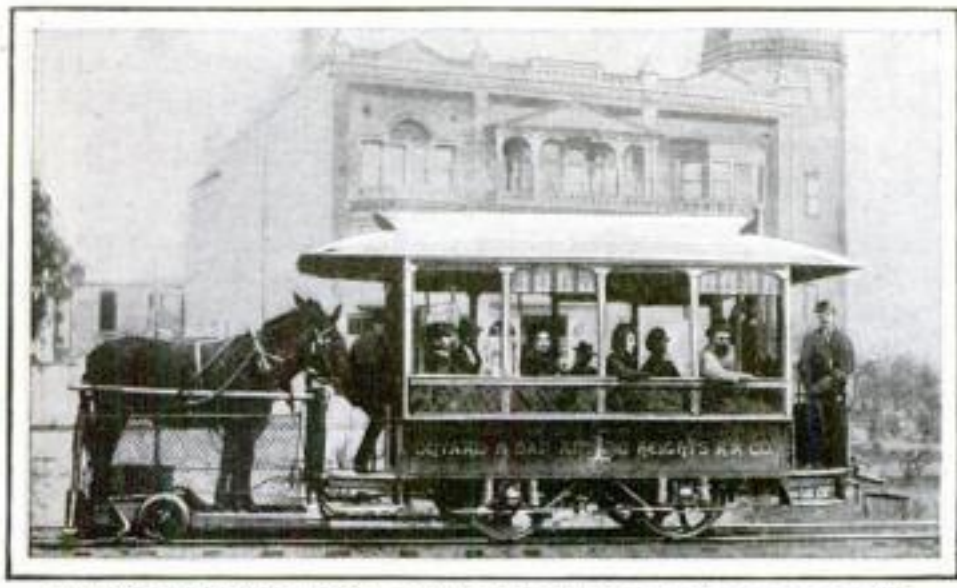
The sprinkler is a perforated pipe beneath the locomotive tender

From Mule to Motor Bus on Street Car Tracks

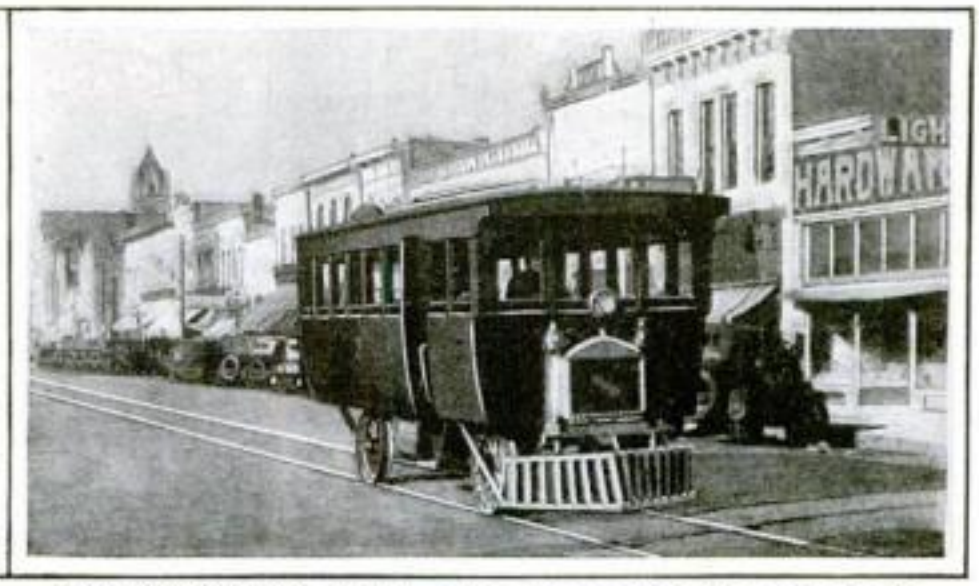
BACK in 1892, the latest word in street car transportation was a private car for the mules that supplied the motive power.

After they had pulled the tiny car up an eight-mile hill near Ontario, Calif., the mules were unhitched and locked on a private platform, while the return trip was made by gravity. But the electric trolley banished the mule, and now the gasoline bus is in many cities eliminating the trolley.

In 1922 the newest improvement is the operation of motor trucks on the car tracks in city streets. The first city to substitute the motor truck for the electric trolley on car tracks is Manhattan, Kans. Light motor buses, with standard chassis and practically unchanged except for the wheels, are said to enable the company to give the same service for 15 cents a mile that cost them between 40 and 50 cents a mile when they were operating with electric trolleys.



THE OLD WAY—After pulling the tiny street car up a hill, the mules made the down trip on wheels

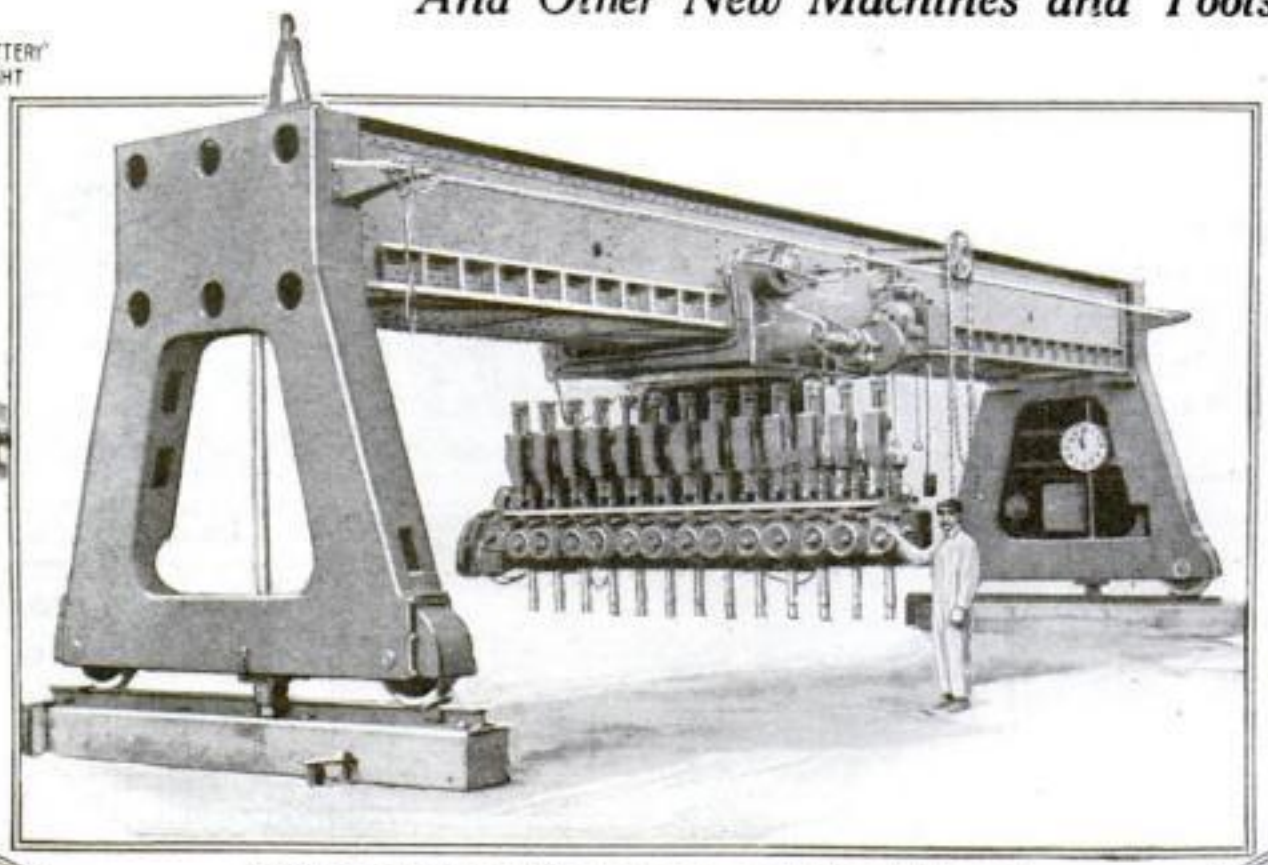


THE NEW WAY—Light motor buses with flanged wheels instead of rubber tires, give cheap service in Manhattan, Kans.

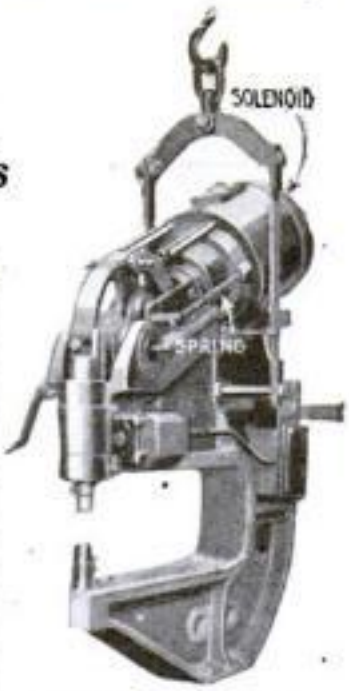
A Monster Steel Plate Drill

And Other New Machines and Tools

This electric crane, of unusual length of beam, rests upon a truck propelled electrically, and if braced with a jack will lift very heavy loads

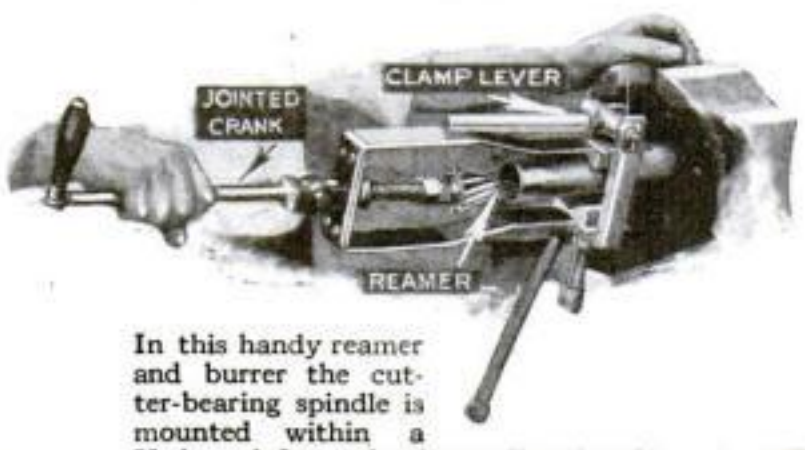


Thirteen adjustable drill heads are mounted on the traveling carriage of this giant multiple drilling machine used for drilling, counterboring, and tapping huge steel plates. The spindles are eight inches apart and are driven by 50-horsepower motor mounted on the carriage



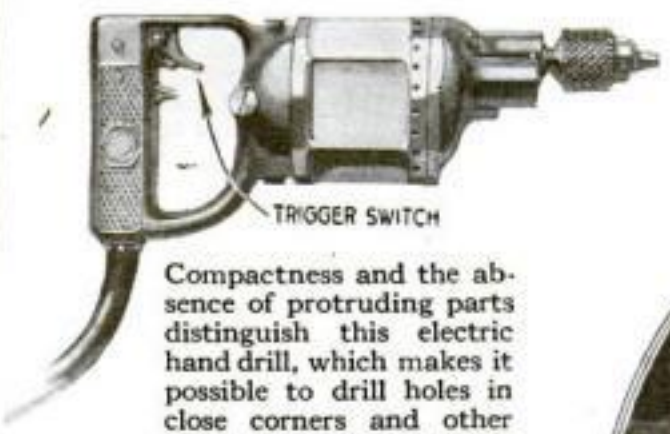
Current passing through the solenoid of this electric riveter, lifts one side of a cam while the opposite side depresses the riveting plunger

The above lathe, automatic in every operation, receives its work from a magazine and delivers the finished article

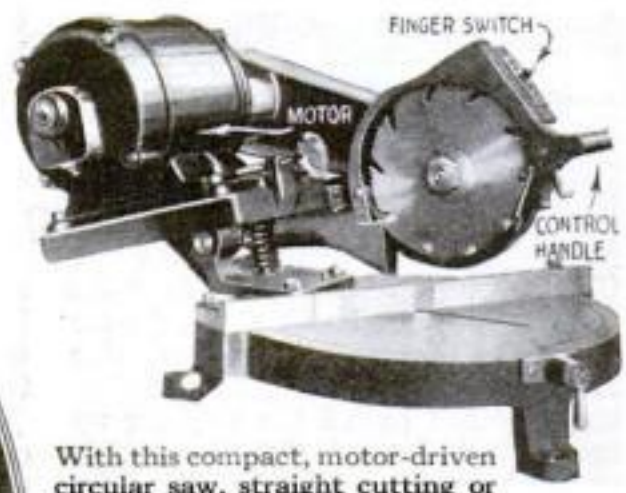


In this handy reamer and burrer the cutter-bearing spindle is mounted within a U-shaped frame having a clamping device at one end and a folding crank handle for turning the spindle by hand

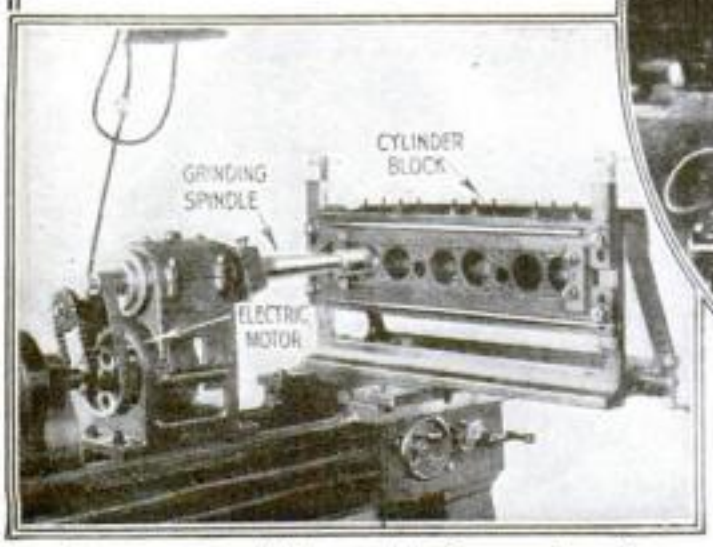
Radially mounted cutting tools of this gear cutting shaper remain stationary while the blank to be cut is pressed against them by a vertical plunger



Compactness and the absence of protruding parts distinguish this electric hand drill, which makes it possible to drill holes in close corners and other difficult places. The drill is operated by a trigger switch

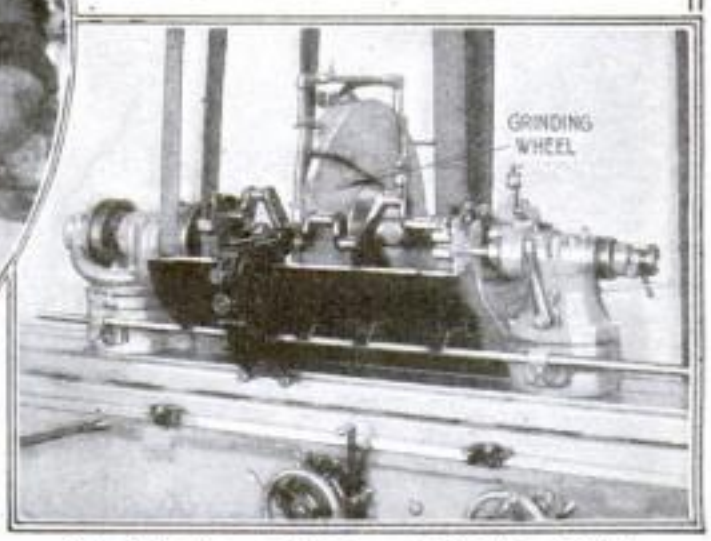


With this compact, motor-driven circular saw, straight cutting or mitering can be done with speed



Every automobile repair shop equipped with a lathe should add this valve grinding attachment driven automatically by an electric motor

The motor's friction wheel, adjusted toward or away from the center of the friction disk of this die filing machine, gives speeds varying from 300 to 700 revolutions a minute



Crankshafts, pistons, wristpins, valve stems, and other automobile parts may be ground accurately with this new type of universal grinding machine

Armstrong's "Radio Flivver"—Langmuir's Super-Tubes—Marconi's Wireless Beam

Jack Binns Explains Latest Radio Progress

Jack Binns, famous wireless operator, and author of important radio articles appearing exclusively in "Popular Science Monthly"

SO ASTOUNDING have been recent radio developments that I suggest a moment's pause in which to take stock of the actual accomplishments of this wonder period, and to analyze their bearing on the future.

Three major inventions recently announced are likely to have revolutionary effects upon communication, navigation, and industry in general. They are: the super-regenerative system; short wave directional communication by means of reflection; and the production of very high powered transmitting tubes.

The Romance of Wireless

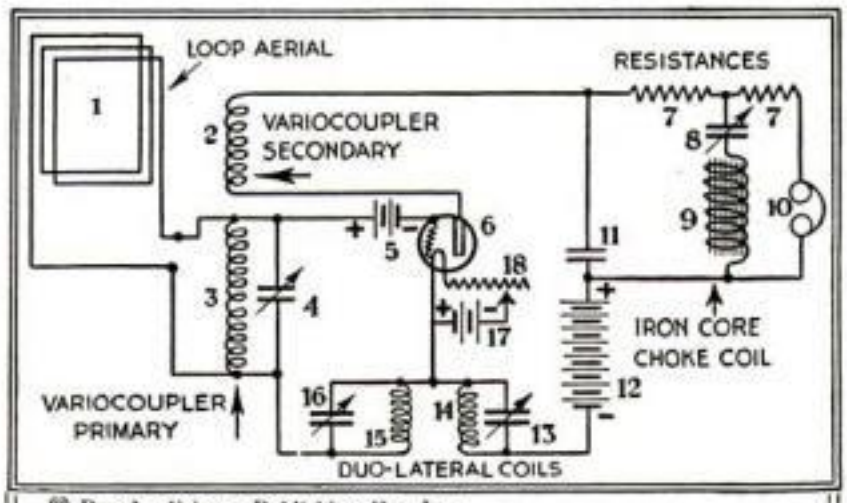
In view of the fact that there is a touch of romance in the possibility of casting one's voice clear across the Atlantic Ocean, I am going to outline the last of the three first.

At first glance it does not seem remarkable that such huge vacuum tubes have been developed, especially when it is taken into consideration that large tubes are in use every day at the radiophone broadcasting stations. It must be remembered, however, that when it comes to designing a glass contained vacuum tube with a power output of 20 kilowatts, difficulties are encountered. The greatest of these has been to devise a suitable means of keeping the tubes cool during continuous operation. The ordinary method of cooling through the use of electric driven air fans does not suffice for the larger tubes.

After a long series of experiments, a 20-kilowatt tube has now been produced, with a water-cooled jacket of special design around its base. This tube is undoubtedly the key that will unlock the door to transatlantic wireless telephone communication. It was one of these tubes with which Dr. Irving Langmuir impressed Senator Guglielmo Marconi on the latter's recent visit to the General Electric plant at Schenectady.

It was my privilege some time ago to witness some of the experiments that were being made with a tube of this kind. This particular tube had a power output of only 12 kilowatts, but the extraordinary stunts performed with it give one a graphic idea of the wonder-working power of the great 20-kilowatt tube.

The tube I saw was supplying oscillating current at radio frequency to a "phantom antenna," which consisted of a bank of 12 incandescent lamps, each of one kilowatt. They were arranged in series with each other. These lamps burned with a brilliancy so terrific that it was impossible to look at them directly, and yet their dazzling brilliance came from the energy supplied by a single vacuum tube that in itself was no larger in over-all dimensions than any one of them.



THE above diagram shows the already famous Armstrong super-regenerative system employing one vacuum tube only. In this circuit the constants are as follows:

1. Loop aerial, 12 turns on a 3-foot frame, wired spirally. 2. Secondary of the regulation variocoupler with twice the usual amount of turns 3. Primary of variocoupler. 4. Variable condenser, .001 mfd. 5. The C battery; 4 volts maximum. 6. Vacuum tube. 7. Resistances, 12,000 ohms each. 8. Variable condenser, .001 mfd. 9. Iron core choke, 100 milhenries inductance. 10. Telephones. 11. Fixed condenser, .005 mfd. 12. B battery, 80 volts maximum. 13. Variable condenser, .0005 mfd. 14. Duolateral coil, 1500 turns. 15. Duolateral coil, 1250 turns. 16. Variable condenser, .005 mfd. 17. Storage battery: 6 volts for UV 201, or 8 volts for UV 202. 18. Standard filament rheostat.

Irving Langmuir—Creator of the Super-Tube

ALTHOUGH best known to the electrical industry as the inventor of the gas filled tungsten lamp, Dr. Irving Langmuir would, no doubt, call this achievement merely his first step in the development of the mighty 20-kilowatt vacuum tube—called the radiotron—a small cylinder of glass and metal, possessing power enough to transmit radio messages thousands of miles. Ten of these tubes—easily carried in one hand—are expected to replace huge generators weighing many tons.

Doctor Langmuir was born in Brooklyn, N. Y., and after graduation from Columbia University as a metallurgical engineer spent three years in Germany at the University of Göttingen, where he was fortunate to study under Professor Nernst, inventor of the Nernst lamp. On returning to America in 1906, Doctor Langmuir became instructor in chemistry at Stevens Institute of Technology, and in 1909 entered the Research Laboratory of the General Electric Company at Schenectady, N. Y., where all of his valuable researches have since been carried on.

Dr. Irving Langmuir, holding in his left hand the new 20-kilowatt tube, the largest ever made. The midget "peanut tube" is shown in his right hand

Those who know him say that the spectacular successes of Doctor Langmuir are due primarily to his ever-present inquisitiveness. He has never been known to take a fact for granted. It was this quality that urged him on to the perfection of the super-radiotron after certain strange actions in the gas filled lamp had piqued his scientific curiosity.

The 20-kilowatt tube—his latest contribution to radio science and designated by Marconi "the greatest development of the age"—contains a grid, a filament, and a plate. The filament is large and rugged and the plate, supplied with a direct current of 20,000 volts, is a metallic cylinder 8 inches long and 1½ inches in diameter, sealed directly into the glass of the tube.

A Beam of Waves across the Sea

CAN you imagine a lighthouse throwing a beam clear across the Atlantic Ocean? It sounds pretty far fetched, doesn't it? Nevertheless, it is one of the myriad possibilities that have been opened up to us by the remarkable success achieved by Senator Guglielmo Marconi and his assistants in the development of electromagnetic waves of one meter in length transmitted in the form of a beam by means of reflectors.

With this system it is quite possible to shoot a beam across the Atlantic or Pacific, and to use the beam as a carrier wave for conversation, music, or telegraphic dots and dashes.

There is romance in the development of these reflected waves, and bound up in it is one of those cyclic recurrences that

dominate history. At the very outset of his career Marconi's first successful wireless telegraph set used reflected waves as the medium of communication between two points. This system was abandoned 23 years ago because it was considered impracticable. Now it comes back to exert a dominant influence.

There is another interesting phase in connection with this new development. Marconi, in conjunction with C. S. Franklin, H. J. Round, and several other young radio engineers, again began to experiment with reflected waves in Italy in 1916. For four years these experiments were carried on with no appreciable progress. Suddenly, in 1919, the human voice was shot over a distance of 20 miles on one of these directed beams. This was quickly followed by greater distances, until 100 miles was successfully negotiated with speech and music.

Wireless History

I am in a position to tell for the first time just how the sudden advance in distance was obtained by means of reflected waves. The scene is laid in a Paris restaurant in January, 1919—that period of lackadaisical existence that followed immediately after the war. There are two chief characters. One of them is H. J. Round and the other Major E. H. Armstrong, of the United States Signal Corps. With the latter are a couple of friends, Harold Lewis and Harry Hauck, also radio experts. The dialogue runs as follows:

ARMSTRONG: Hello, Round! What are you doing here?

ROUND: Oh, I'm just having a rest after doing some special work. We've got something pretty good.

ARMSTRONG: I've got something pretty good too. Want to see it?

Armstrong then shows Round his super-heterodyne receiver—"the Rolls Royce of radio"—which he has just perfected and proceeds to explain it to him in detail.

ROUND: By Jove, old man, that would come in pretty handy for the work we're doing now! I'd like to use it.

The permission was readily given, and thus it was that the abrupt and phenomenal increases in distance obtained by Marconi and his associates in the short-wave directional experiments were possible through the young American's invention—the super-heterodyne.

Such, in brief, is the inside history of the successful development of reflected wave radio. It might be well now to point out some of its immediate applications. One is the revolving radio lighthouse, and the other directional secret communication.

Experiments already conducted in conjunction with the British Lighthouse Commission at Inchkeith off the coast of Scotland, have been eminently successful, and the system is much more rapid in its functioning than is the radio direction finder. In this system the reflector revolves in the same manner as a light reflector does in the ordinary type of lighthouse. It is connected with an automatic transmitter that sends out pre-arranged letters in the telegraphic code at predetermined intervals. With this system a ship caught in a fog is amply warned of the proximity of danger.

An effective extension of this system suggests itself for use in mid-ocean, and there is no doubt that its application will practically eliminate the possibility of collision at sea. Even if one of the ships is not equipped with the system, the other ship, getting the wave reflected back as soon as it strikes the metal side of the ship that is not equipped, will be warned of the nearness of the latter.

Reflected Waves

Now that the development of receiving apparatus is progressing rapidly, especially from the point of view of ultra sensitivity, the reflected wave system will be invaluable in future trans-oceanic telephone communication. It will cut down the amount of power necessary to bridge the ocean with the human voice, because all of the energy carrying the voice will be going to the desired destination without being broadcast. It will also enable the use of a tremendous number of transoceanic stations at the same time, a condition that is not at all possible on the longer waves.

There is another important possibility. By means of the heterodyne principle, a steamship can be directed straight across the Atlantic or Pacific without varying an inch off its track, irrespective of weather conditions, by simply keeping in receptive touch with the reflected signals at all times. The beat note produced by the heterodyne could be attached to a loudspeaker, so that the helmsman would know immediately when he went off his course, because the moment he did so the signals would cease.

Transatlantic Talks

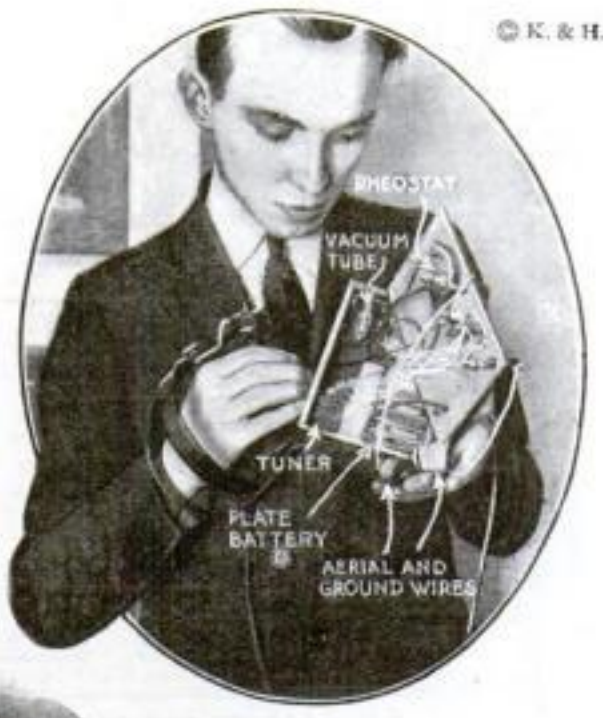
AT THE outset I stated that it was an open secret that transatlantic tests of radiotelephony were about to be undertaken. In this connection it will interest

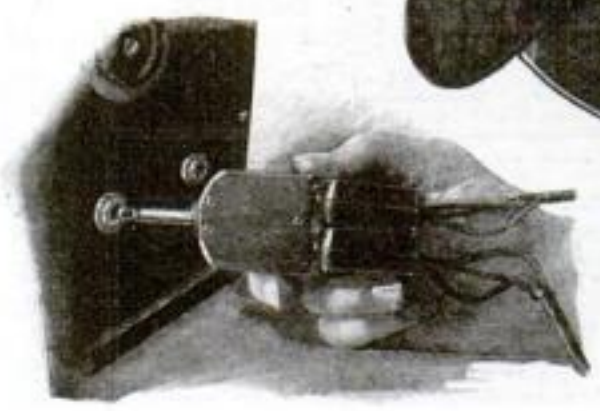
(Continued on page 107)

What Inventors Are Doing in Radio

Smallest Vacuum Tube

A SPIDER web tuning coil, a miniature vacuum tube operated on a dry cell, and a standard rheostat comprise the smallest vacuum tube receiving set in the world, for which Sterling G. Sears was awarded a prize at a recent radio show in New York City. Taps brought out from the inductance to a switch on the cover of the case provide for close tuning





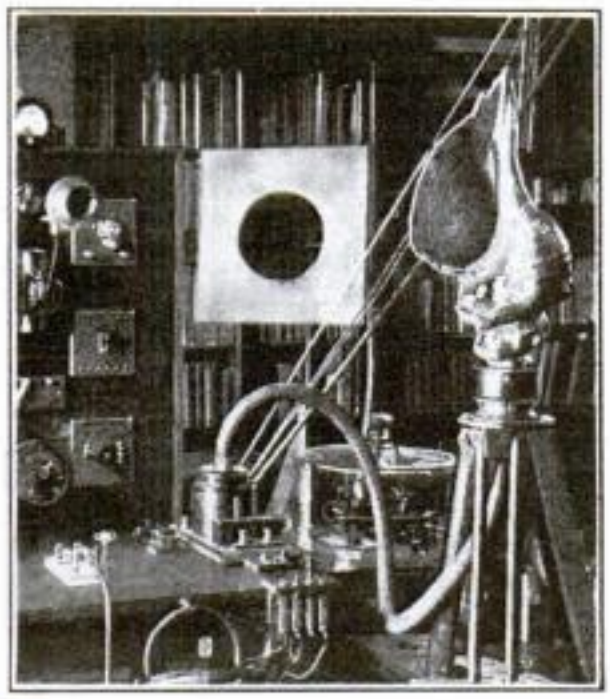
Six Phones at Once

BY COMBINING a multiple jack and plug adapters (at left), six phones can be connected simultaneously with one receiving set

Novel Loudspeaker

BY ADAPTING the familiar triton shell of the seashore to the rôle of a loudspeaker, Rev. Frederick L. Odenbah, director of the observatory at St. Ignatius College, Cleveland, Ohio, has succeeded in reproducing jazz music with all its harmonics.

The loudspeaker was constructed by cutting off the small end of the shell and inserting one end of a rubber hose leading from the amplifying diaphragm of the receiving set



Radio Set in Cane

A RADIO receiving outfit incased in a hollow cane that incloses a fishpole aerial, has been devised by C. H. Shipton, of Seattle, Wash., whose radio set in a razor case was described recently in POPULAR SCIENCE.

A single phone receiver is attached to the upper end of the cane stock. Tuning coils wound in multi-layer form are inclosed in the handle, with taps taken off for minute switches. Pinheads are used as switch points

Why I Believe in Government Radio

Famous Advocate of a National Broadcasting System Says It Would Improve Wireless Programs

By Charles E. Duffie

"WE ARE only playing with radio today. I may startle most people by my assertion, yet I firmly believe that in the practical application of the radiotelephone—especially for broadcasting news over wide areas—Europe has been in advance of the United States. Here, we have developed the receiving end to an almost fantastic degree, but the broadcasts received here have been largely in the nature of amusing vaudeville, and in the past few months there has been no lack of rumors from the public that this type of amusement is losing its appeal. Europeans, on the other hand, have had the broader vision of perceiving that the really magnificent future of radio lies in the spread of news and vital information."

These are the words of a man whose opinion is going to count mightily in the next few years. He is R. B. Howell, general manager of the successful Municipal Water Works and Gas Works of Omaha, Nebr., the Republican nominee for Senator from Nebraska this fall, and probably the leading advocate of government broadcasting in this country. Himself a radio amateur and engineer of note, who has operated his own broadcasting station in Omaha, Mr. Howell, through an official investigation of the broadcasting situation here and abroad, made for the United States government, has had an unparalleled opportunity to acquire a definite picture of what radio may ultimately mean to the public.

A very common question lately, among users of home radio sets, has been, "What sort of broadcasts are we going to receive this fall?" The question reflects a prevalent discontent with the indiscriminate competitive jumble of phonograph music, uninteresting lectures, and disguised advertising talks, which have, in part, made up many programs.

There are those who believe that the only possible solution of the situation lies in government broadcasting, and the most famous of all advocates of this belief has been Will Hays, formerly Postmaster General, and now so-called Dictator of the Movies. But while Mr. Hays gave to the idea, for a time, the prestige of his name and official position, his jump into other fields has silenced him on this subject, leaving Mr. Howell indisputably the country's most capable and best informed booster of a national system of broadcasting by Federal and state agencies.

R. B. Howell, radio expert and candidate for Senator from Nebraska

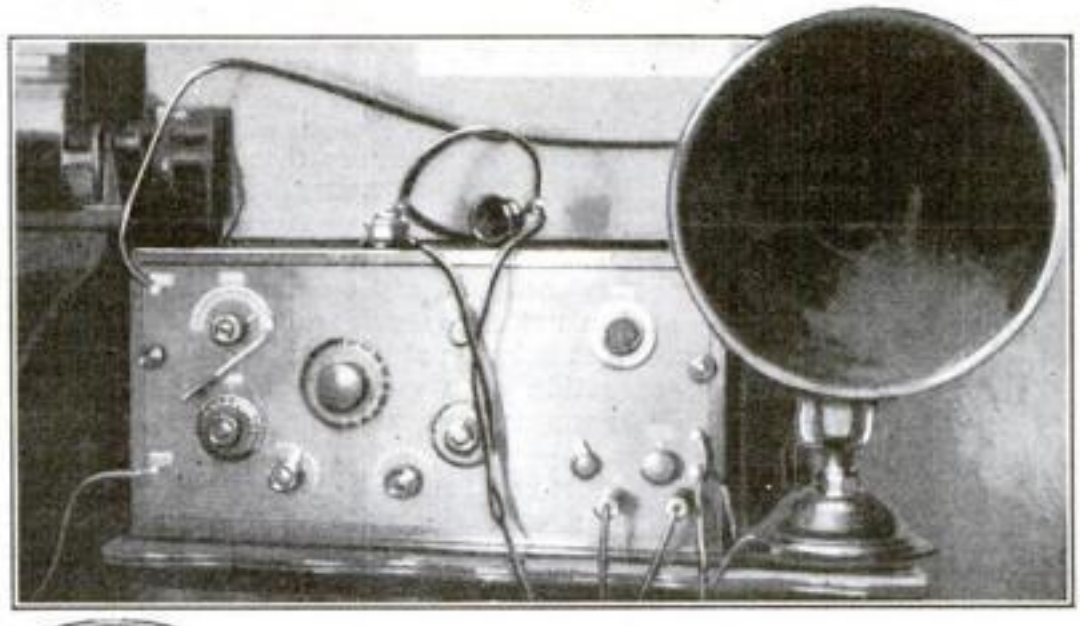
It was Mr. Hays who, a year ago, sent the Omaha utilities expert abroad on his mission of radio investigation. In the following interview given to me for POPULAR SCIENCE MONTHLY, Mr. Howell tells for the first time to the American public as a whole the results of his investigation, and the reasons that make him an ardent advocate of government broadcasting.

"In Europe—especially in Germany—I found that the control both of sending and receiving stations was entirely regulated by the government," said Mr. Howell. "The German plan is to broadcast news of different kinds on different wave lengths. The German Post Office plans to sell, adjust, and maintain receivers that will be set to respond to but one wave length. Thus the subscriber, if he wishes to hear financial news, may hear that kind of news only—and he will pay a certain sum for the service; or he may have several receivers and get all the broadcasts.

"In this country, of course, it is impractical to try to exercise control of receiving sets. Such control is not in harmony with our ideas of popular government; and if it were, there are now so many sets in operation that an attempt to restrict them would cause an uproar.

"But we must follow our ideas of free and unrestricted receiving to the logical conclusion, and this, to my mind, means broadcasting by the government itself, which is the only

Popular Science Monthly's Great Radio Set



Leslie S. Greenslade, of Hamilton, Ont., and above, the attractive and efficient receiving set that he built from the Popular Science Monthly blueprint. With this set and an average aerial he has heard clearly most of the broadcasting stations in the Eastern United States

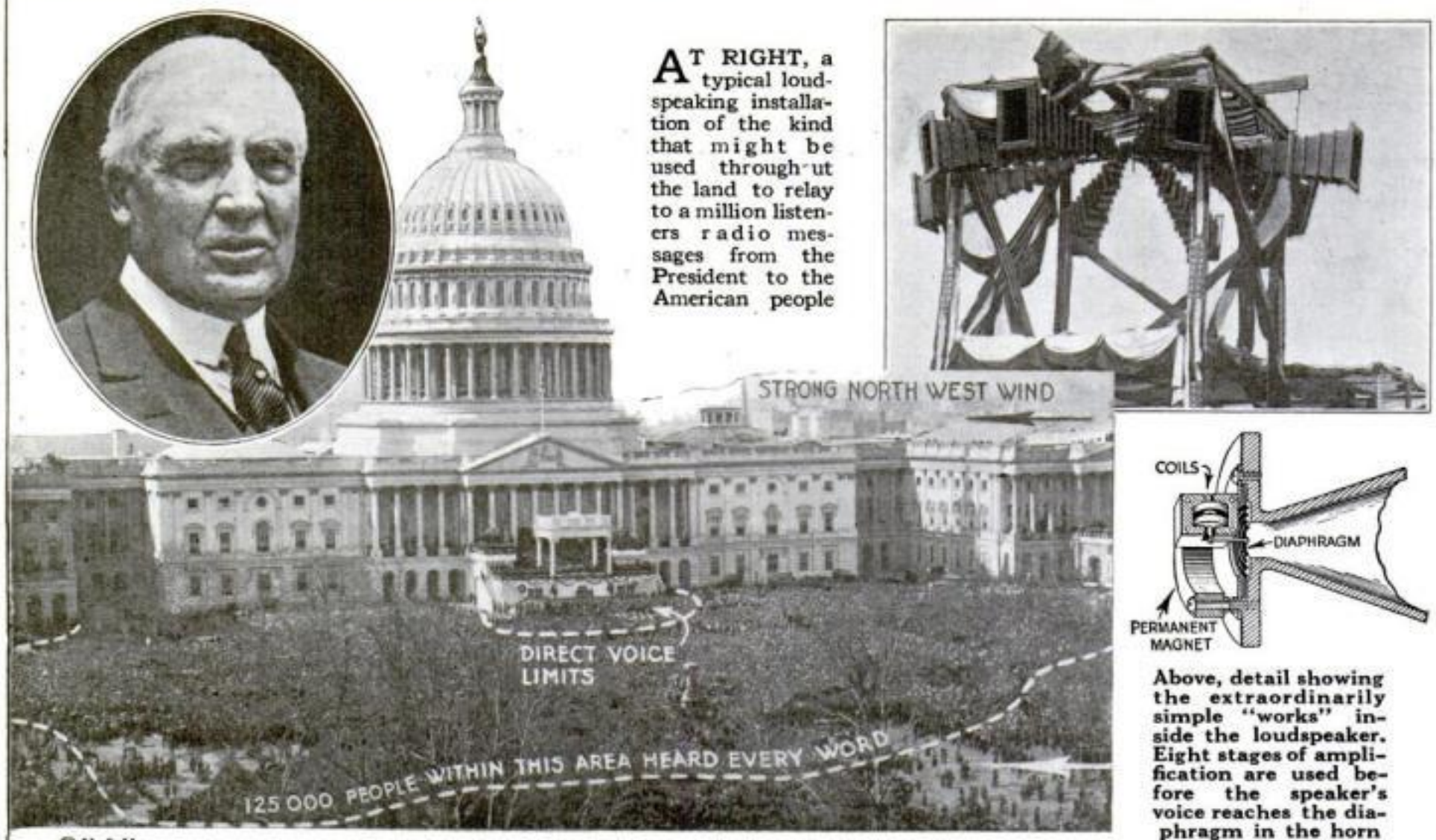
TYPICAL of scores of letters from readers telling of unusual success in receiving broadcasts with radio sets made from the POPULAR SCIENCE MONTHLY two-stage receiving set blueprint (see page 91 in Home Workshop Section) is the following sent to us by Leslie S. Greenslade, 475½ King St., Hamilton, Ont., Canada:

"I have had wonderful results with a receiving set made from your blueprint showing a two-stage amplifier. I have heard clearly music and voices from Anacostia (NOF), 335 miles; Chicago (KYW), 380 miles; Madison (WHA), 475 miles; Newark (WJZ), 332 miles; Schenectady (WGY), 285 miles; Parkersburg (3ZO), 215 miles; Pittsburgh (KDKA), 215 miles; Detroit (WWJ), 190 miles, and from many others.

"My aerial consists of a single wire No. 12 stranded, 150 feet long, 90 feet high at the lead-in end, and 65 feet high at the far end. My ground is a No. 4 wire leading down the outside wall to a water pipe in the basement.

"The large size specified for the panel is a real advantage because all the B batteries can be inclosed in the cabinet and still leave room for two stages of radio frequency amplification if desired.

"Every one who has seen or heard the set has wanted to know where the blueprint came from."



AT RIGHT, a typical loudspeaking installation of the kind that might be used throughout the land to relay to a million listeners radio messages from the President to the American people

Above, detail showing the extraordinarily simple "works" inside the loudspeaker. Eight stages of amplification are used before the speaker's voice reaches the diaphragm in the horn

© U. & U.

THE enormous power of loudspeakers now available is illustrated by the above photo of the famous scene when President Harding delivered his inaugural address. Investigation of audibility made it possible to plot the exact range of the amplifiers, as indicated in the picture.

It is remarkable that while the President's words were carried distinctly to listeners on the outskirts of the crowd, they were not made to sound too loud to people directly under the amplifiers. The reproduction of his voice by the loudspeaker was so perfect that those in the first rows could not tell where the natural voice left off and where the amplified voice began. Walking away in a straight line from the platform, one could have detected no change in tone and but small variation in the volume.

Under a completely national system of government radio broadcasting such as that proposed by Mr. Howell in the accompanying article, it has been suggested that important public addresses and debates on vital political problems, like the bonus, tariff, and prohibition, would be broadcasted over the whole country from Federal transmitting stations, and received not only by home radio users on their own sets, but also by huge crowds like the above, gathered around loudspeaking installations in the parks and other public meeting places of big cities.

logical agency for this work. In the first place, the government has the greatest vested rights in radio. Furthermore, during the world war, the government practically financed the experiments that have led to today's perfection in radio apparatus. Private enterprises control the radio patents, but *the government controls the ether!*

Necessity of Close Control

"In the two conferences held by the nations of the world to allocate wave lengths, the United States asked for but 35. These, for the use of a nation of 100,000,000 people, mean that if radio is to be a great public utility (which it will be if properly handled), sending apparatus must be closely controlled.

"The erection of transmitting stations would not exceed a cost of two cents a square mile of territory served.

"Such a radio broadcasting service must include, in addition to news bulletins, market and weather reports, other features, such as short stories, discussion of popular current topics, and music and other entertainment of the highest type.

"As an instance of what might be accomplished, I believe that a telegraphone can be used to record Metropolitan grand opera in New York or elsewhere, the reels of thin wire then being sent in turn to the various transmitting stations, all at the cost of one recording. Necessarily, such a service would require a central staff of highly competent experts to prepare and edit programs.

"Only the government, in my opinion, can operate such a national service without hopeless conflict between stations, and the rational operation of a government-owned 'radio' newspaper would bring wonderful results."

Mr. Howell's interest in radio began when, in 1908, he entered the fight to allow Omaha to buy the then privately owned water plant. Being powerfully opposed in his course by one of the newspapers, he was eager for some means of securing publicity, other than the usual sources at his command. Remembering that he had read of the slight success of the radio-phone in the navy, he wrote to Admiral Kountze, an old classmate, and inquired as to the practicability of the radio transmitter. The reply was, in effect: "Great future, not practical now, as it is little more than a scientific toy."

Hungary's "Telephone Newspaper"

He never lost interest in radio, however, and on March 4, 1921, while lunching with Postmaster General Hays, suggested the publication of a radio newspaper by the government, touching on the success of the so-called "telephone newspaper" of Budapest, where such a paper had been "published" for more than 25 years. Mr. Hays immediately expressed great interest. In less than six weeks, the government began to broadcast weather and market reports from the air mail stations, by radiotelegraphy. The Radio Service Commission was soon after appointed, with Mr. Howell as chairman, and he sailed for Europe September 3, 1921, to investigate radio- and wire-telephone broadcasting.

Recounting in his talk with me some of the things he learned about European broadcasting, Mr. Howell described a novel experiment in Holland. "On the fifth of January, 1921," he said, "the Amsterdam Bourse began the broadcasting of Bourse news and quotations to some 200 banking and brokerage houses throughout Holland. It was a coöperative enterprise, each banking house contributing about eight dollars a month for the service, which includes the supplying, installation, and maintenance of a receiving station.

How Europe Does It

"An interesting form of receiving station developed by the Germans for their post office broadcasting service includes an electric bell, calling subscribers to the phone when special news outside of the regular schedule is about to be transmitted.

"The Hungarians have done little with the radiotelephone, but in Budapest there is a highly interesting development in the form of a telephone newspaper that is now in its twenty-eighth year of publication. This enterprise consists of 42 party lines, serving some 6000 subscribers. Each station has two or more receivers, but no transmitting apparatus. It is the stentor at the central office who does all the talking over this system of wires, and is heard by all subscribers at one and the same time. The transmission of news begins at nine o'clock in the morning and is carried on throughout the day in accord with a fixed

schedule, so that any one interested in a particular class of information knows just when to listen in. In the afternoon a short story is offered, or a chapter from a continued story. At four-thirty the concert of the Imperial Band begins, transmitters being placed about the band stand. While in the offices of this unique newspaper, about five o'clock one afternoon, I heard the stentor announcing the personnel of the artists who were to sing at the Budapest Opera House that evening, and later, at the home of the manager of this newspaper, I enjoyed the privilege of listening to Wagner's 'Die Walküre,' in common with other subscribers throughout the city.

A NATION-WIDE government broadcasting service would become, in its way, as important to the public welfare as is the Postal Service today.

"All that has been done of this character with the wire telephone can be done with the wireless telephone. While Will Hays was Postmaster General, he conceived a concrete plan for the installation of radio broadcasting stations throughout the country, say about 400 miles apart, so that weather and market reports, news bulletins, and, incidentally, amusement, might be afforded to our widely scattered population in their own homes. Under this plan, each listener would provide his own apparatus, while the government would bear the expense of the installation, maintenance, and news service of the transmitting stations.

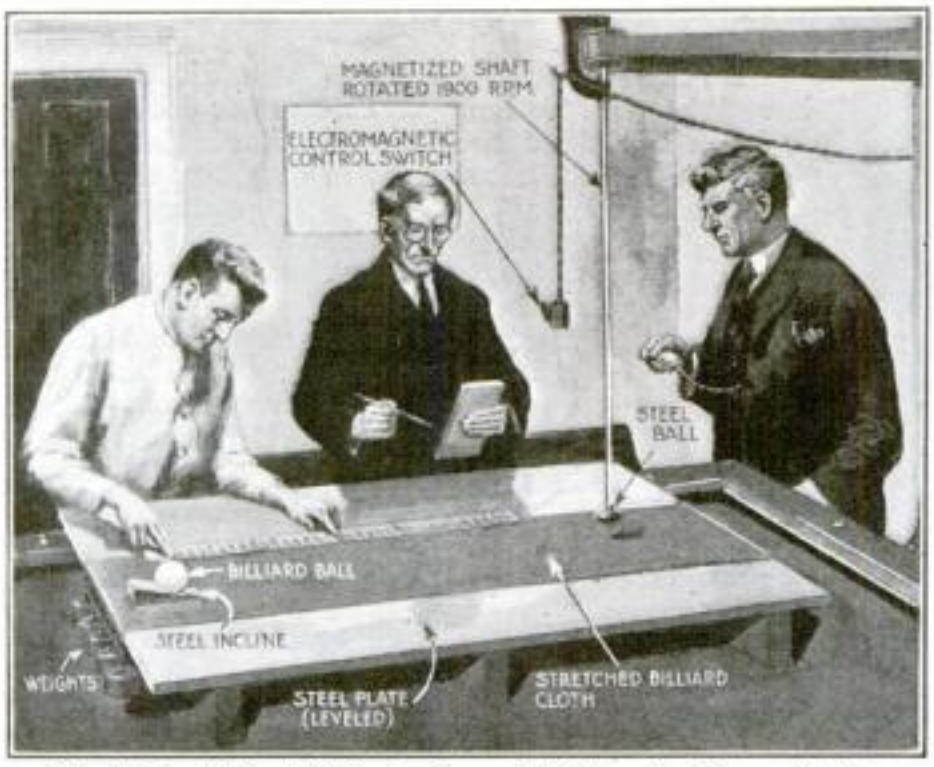
"But to be successful, the service would have to be *dependable*. Stations must be powerful enough to 'get through' under all

(Continued on page 107)

Play Billiards with Magnetized Cue

SLACK in the cloth covering on billiard tables will reduce the length of the estimated roll of the ball from 5 to 10 per cent, according to recent tests conducted by the Bureau of Standards. But the direction of the nap makes little difference.

The test method consisted in measuring the distance traveled by a standard billiard ball after rolling down an inclined plane onto samples of the cloth stretched over a steel surfaced plate. The tension was varied by weights attached to the ends of the material.



The ball at the left is testing cloth for tension. At the right the steel ball measures resistance to spinning

Additional tests were also made to ascertain whether different kinds of cloth had any effect in retarding the spin of balls. A two-inch steel ball was supported by an electromagnet on the lower end of a vertical steel shaft. With the ball held just above the surface of the cloth, the shaft was brought up to a speed of 1900 revolutions a minute. Then the magnetism was destroyed and the spinning ball dropped on the sample of billiard cloth stretched tightly over the steel surface plate. By noting with a stop watch the time required to bring the spinning ball to rest, it was found that the difference of one cloth over another was too slight to be noticeable.

Big Wash Bowl Shakes Mud from Cars

HUGE wash bowls, around which automobiles are run to remove the dirt from the under body, have been installed near a St. Paul, Minn., garage. The bowls are 75 feet in diameter and accommodate six cars at a time.

The wash bowls are shallow concrete basins sloping gradually from the outer edge to the center, with water varying from a few inches to 34 inches in depth.

A few turns around the bowl remove hard-caked mud and grease. Figures on the tags indicate depth of water.

Separate ramps lead to the basin for incoming and outgoing cars. As the car goes down the ramp, an attendant clamps a waterproof cover over the radiator. On the bottom of the basin concrete strips one inch high radiate from the center and as the cars pass over them the vibrations shake the loosened mud and grease from the metal parts.

Compressed Air Grease Gun Measures Lubricant

A GREASE machine operated by compressed air and adjusted by a valve to dispense exactly one half pound of lubricant at a time is now being used by garages to insure accurate measurement of the grease used in filling transmissions, differentials, and timing gears.

The lubricant is poured into the top of a 12-gallon container that is connected with an air chamber. Compressed air is let into the chamber until a pressure of 75 pounds is obtained. From the lubricant holder a flexible hose leads to the grease gun.

To fill a grease cup the snout of the gun is inserted into the opening of the cup and a valve on the gun given one complete turn. The compressed air forces one half pound

By turning the valve a supply of grease passes into the cup

of the grease out of the container. Another turn of the valve will force another half pound, and so on. A neutral point on the valve permits the operator to stop the grease flow at any point.

By means of a pair of trucks on the base, the machine can be wheeled with ease.

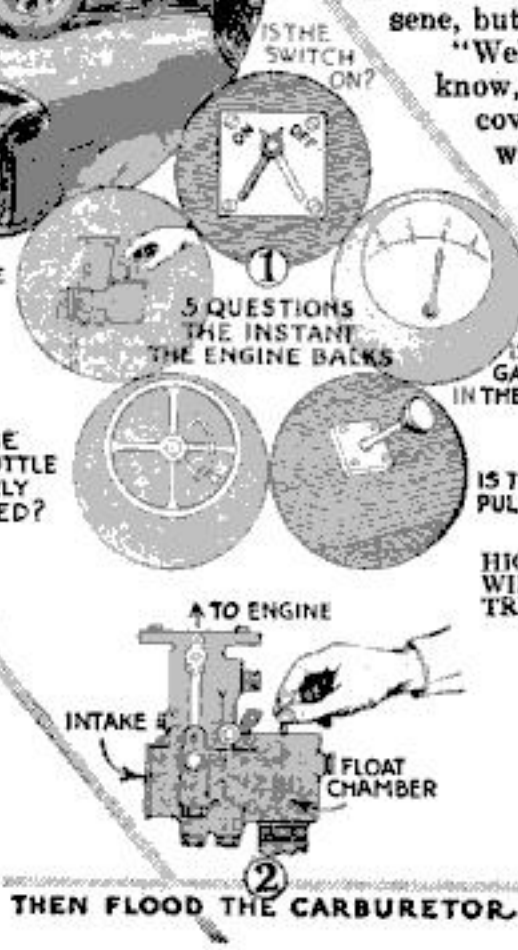
Horses Shod with Copper

RECENTLY all the horses on a California ranch were reshod with copper shoes. It was believed that the steel shoes previously worn had generated sparks that set fire to the dried grass by striking pieces of loose flint.

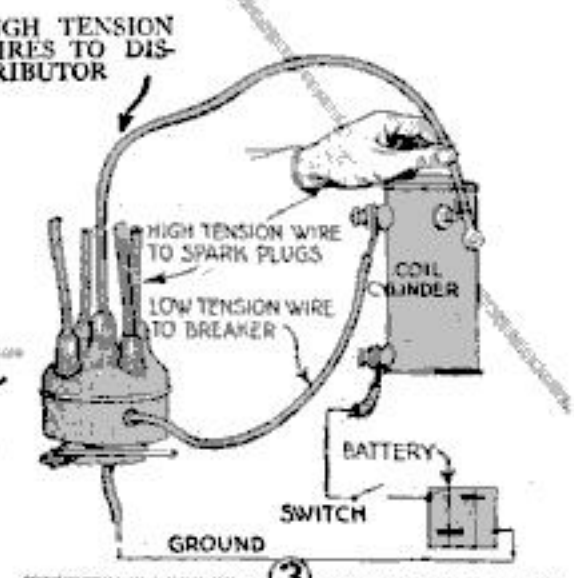
STALLED!

How to Find the Trouble Quickly when Your Engine Dies

By Harold F. Blanchard

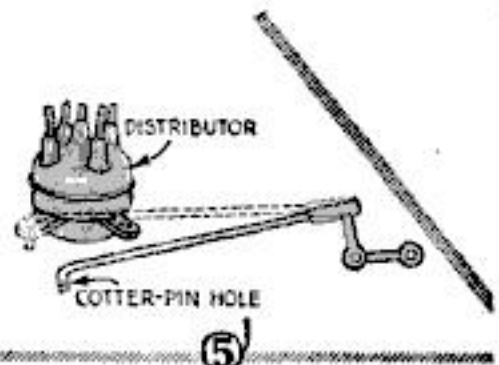


2 THEN FLOOD THE CARBURETOR

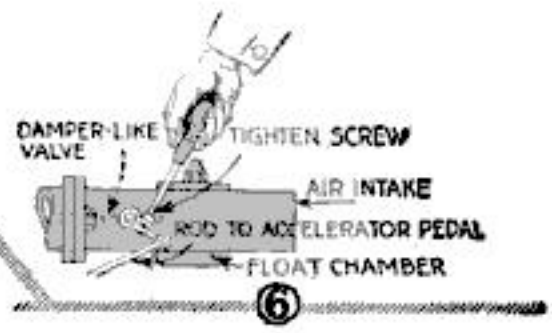


3 LOOK FOR LOOSE WIRES

4 GASOLINE-FILLED OIL-CAN TO PRIME ENGINE



5 IS SPARK ADVANCE MECHANISM DISCONNECTED?



6 THE THROTTLE MAY STICK OPEN

These illustrations, numbered to correspond with the numbered paragraphs in the article, show the simple clues that are easy to follow in playing detective over a dead engine.

1. As soon as the engine balks, make all five tests illustrated.

2. Flood the carburetor by pulling or pushing on the needle valve.

3. Look sharply for loose ignition wires and defective insulation. A binding nut may have fallen off, as indicated

4. If the engine still refuses to go, prime it with gasoline, using an oilcan or squeezing it from a saturated rag. About a teaspoonful in each cylinder is enough.

5. See that the spark advance mechanism has not allowed the distributor to slip out of time. The loss of a cotter pin may have permitted it to slip into the position shown below by the solid line

6. This may be caused by looseness of the setscrew shown above

WHEN your engine goes dead, how long does it take you to locate the seat of the trouble and get under way again? I am willing to wager you have often spent anywhere from 10 to 20 minutes in unsystematic fidgets over the situation—and perhaps have even resorted to the expense of calling a trouble car from the garage.

Yet a simple common-sense system, coupled with real knowledge of your car, is all that is necessary to make the investigation of a dead engine an amusing rather than expensive experience, and, incidentally, to start the engine again in a minimum of time.

A recent experience of my own will make this clear.

I pulled up on a country road, the other day, to help a stalled and obviously puzzled motorist. He couldn't start his engine, yet he couldn't find a single thing wrong with it.

When an Expert's on the Trail

As I walked over to his car, I noticed that the gasoline gage read half full. I turned on the switch, opened the throttle just a trifle, pulled out the choke and stepped on the starter. Nothing happened. I then flooded the carburetor. Some of the fuel spilled on my fingers, and it did not feel exactly like gasoline. I sniffed it, then went to my own car and pulled out a squirt can full of gasoline. I primed the balky engine and she responded splendidly for a half dozen revolutions, and then died.

"What's the matter?" asked the stalled motorist.

"Kerosene," I replied. "The last place you bought gasoline must have filled you up with kerosene instead."

"What I'd like to know," the man interjected, "is how I managed to get this far, if the trouble was caused by kerosene."

"That's easy," I returned. "Your engine was warm when you bought that fuel. But when you got out here you stopped for a couple of hours, and the engine cooled off. A warm engine will run on kerosene, but a cool one won't."

"Well, another thing I want to know," he said, "is how you discovered inside of two minutes what I hadn't found out in half an hour."

"A logical system plus observation," I replied. And the fact is that detecting the cause of a dead engine is as interesting as taking part in a detective story, if you follow a systematic procedure and use your eyes and head as you go.

1. ANSWER the following questions:

Is the switch on?

Is there gasoline in the tank?

Is the choke pulled out?

Is the throttle nearly closed?

Is there gasoline in the carburetor?

These are obvious questions, but it is folly to proceed until they have all been answered.

Difficulty in starting an engine, especially at night, is often due to failure to turn on the ignition switch not only part way, but all the way.

The next thing to determine is whether there is *actually* gasoline in the tank. What you think does not matter. Tanks and pipes spring leaks, you know.

Next, be sure that the choke is pulled out. A great many cars cannot be started otherwise. Then see that the throttle is open only a little, perhaps one eighth.

2. FLOOD the carburetor by lifting the needle off of its seat. If after a few moments gasoline streams out, it shows that lack of fuel at the carburetor is not the cause of the stoppage. If the carburetor does not flood, and yet there is gasoline in the tank, it shows the pipe is stopped up, or that the vacuum system is not working properly.

System Eliminates Trouble Spots

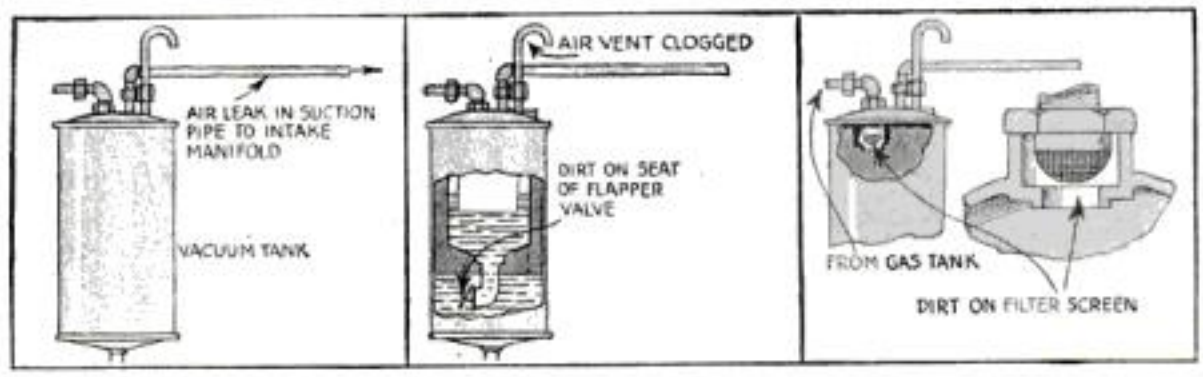
3. LOOK for loose wires. A few moments should be sufficient to detect any trouble here, and remedy it, if found. If not, we know by now that the trouble is not in the wires, nor in the fuel system, unless, possibly, it is within the carburetor itself.

4. OUR next step will show whether the balkiness is caused by the ignition or by some derangement of the carburetor. We'll prime the engine by introducing about a teaspoonful of liquid gasoline into each cylinder. Then we'll turn on the switch and crank it. If we obtain any explosions at all, it is reasonably safe

Vacuum Tank Troubles

VACUUM tank troubles that may stall the engine are made clear in diagram at the right. They are easily cured but still more easily avoided. A gasoline filter will prevent two of them, as well as insure against much carburetor trouble, while a leaky suction pipe is cured by keeping its connections tight.

If the air vent closes, fuel cannot flow from the lower part of the vacuum tank to the carburetor. If dirt lodges on the flapper valve, fuel that flows to lower tank when suction is shut off will be drawn back into the upper tank when suction is on again. There is a small filter screen where the gasoline pipe from the main tank enters the vacuum tank. Keep it clean. Leaky floats are almost unheard of; however, a leaky float will cause raw gasoline to flow into intake manifold and the engine will exhibit symptoms of a very rich mixture.



to assume that the trouble is in the carburetor. But if no explosions are noted, the trouble must be in the ignition.

5. DON'T forget that the failure of the functioning of the simplest car parts occasionally causes engine stoppage. The distributor may become turned around, or

6. THE throttle may stick open, or the switch may not close the circuit, or the ignition drive may fail or slip out of time. Rare difficulties such as these should be kept in mind, while a search is made for the more common troubles.

We'll assume, first, that priming the engine brings forth no explosions. Careful observation shows that outside of the causes of engine stoppage already mentioned, the ignition system usually is the seat of the trouble.

7. THE first place to look for ignition trouble is not at the source—the battery—but at the breaker points. If the points are not smooth, they should be filed, or removed and ground on an emery wheel, until they are smooth and true. Then they should be replaced and adjusted carefully. The correct gap differs according to the ignition system, but it is somewhere between the thickness of a newspaper and 1/64 inch. Before adjusting the points, be careful to turn the engine over, so that the breaker arm is resting directly on the top of its cam.

8. IF THE engine still refuses to run, our next job is to determine whether current is flowing through the low tension circuit.

Turn the engine over until the points are separated, turn the switch on, and then short circuit the points with a small piece of wire. If a crackling spark shows that good current is flowing, it is more than probable that the low tension circuit will be found to be all right.

9. ON THE other hand, if the spark here is feeble, or is not evident, it is probable there is something wrong with the low tension circuit. The battery must be considered O. K. unless it is too weak to do more than make the lights glow faintly. Some of the wire connections may be loose or dirty, or the insulation on some wire may have worn away, allowing a short circuit. Or a grounded strand of wire may be causing the trouble.

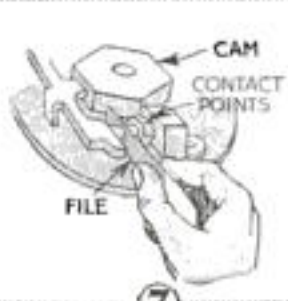
You see, the science of deduction plays a most important part in curing a balky engine. By carefully examining our various clues, we are led to concentrate on the ignition system, and it is logical to study the low-tension or low-voltage half of the system exhaustively before considering the high-tension system.

No possibility can be overlooked. The low-tension wires must not be short circuited, the switch must function properly, the connections must be clean and tight, and the condenser must be sound. If the condenser is punctured, it is possible that the current will leak through it, rather than flow through the breaker points when they are closed. However, if the condenser fails, this fact should also be indicated by excessive pitting of the breaker points.

10. IF NO fault is found in the low-tension circuit, proceed to the high tension. There are very few derangements of the latter which will cause missing. Wet wires, short circuit in the spark gap, leakage of current from the main wire running from coil to distributor,

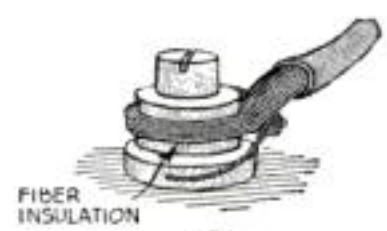
(*Continued on page 72*)

A large percentage of ignition trouble is found at the breaker points. They must be smooth and in good adjustment. A single strand of loose wire touching the metal base may be the unsuspected source of difficulty

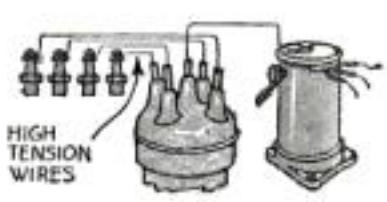


(7) IF THE POINTS ARE NOT SMOOTH, USE A FILE

(8) SHORT CIRCUIT WITH A SMALL PIECE OF WIRE



(9) A LOOSE STRAND OF WIRE MAY BECOME GROUNDED

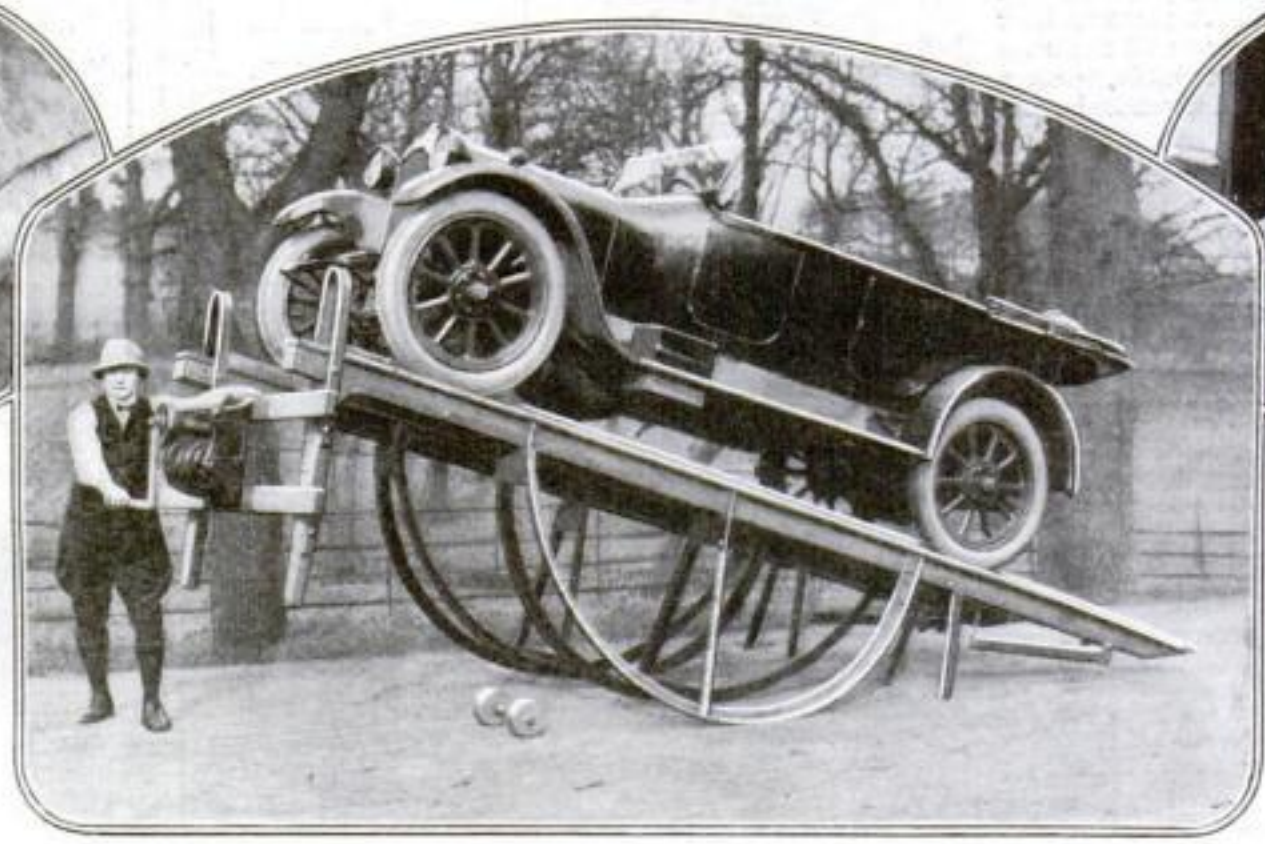


(10) IF THESE WIRES BECOME WET, THE ENGINE WILL NOT RUN

Portable Track Simplifies Automobile Repair

Eight Other Inventions for Car Owners

One end of this L-shaped spark plug tester is slipped under the terminal while the lower end, fitted with an insulated button, is pressed against the base of the plug

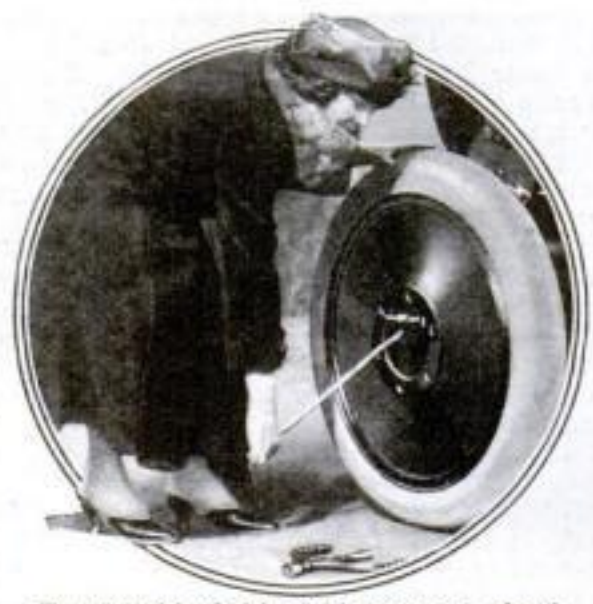


To facilitate repairs under the car, this track on rockers is useful. With the track lowered at one end, the car is drawn up the incline by a hand winch. The track is then braced horizontally

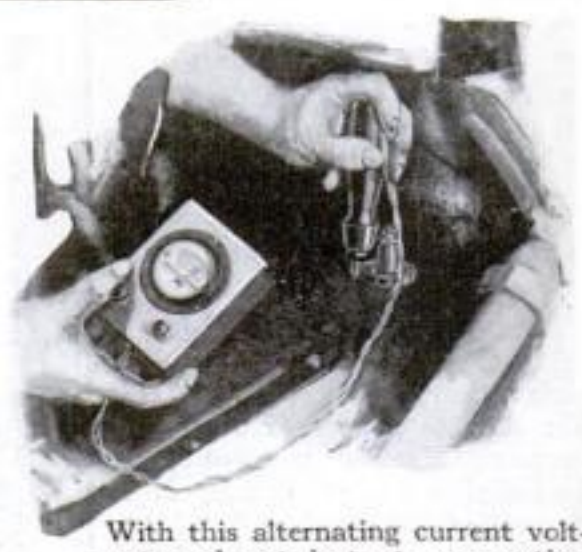
During long rides, this arm rest, with its rubber protected supports, which can quickly be attached to any closed car, will be found a source of great comfort to the driver

AS A special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in this issue

Equipped with a flexible steel hose, reaching to the opening of the gasoline tank, this new type of can makes it possible to fill the tank without a funnel and without danger of spilling a drop

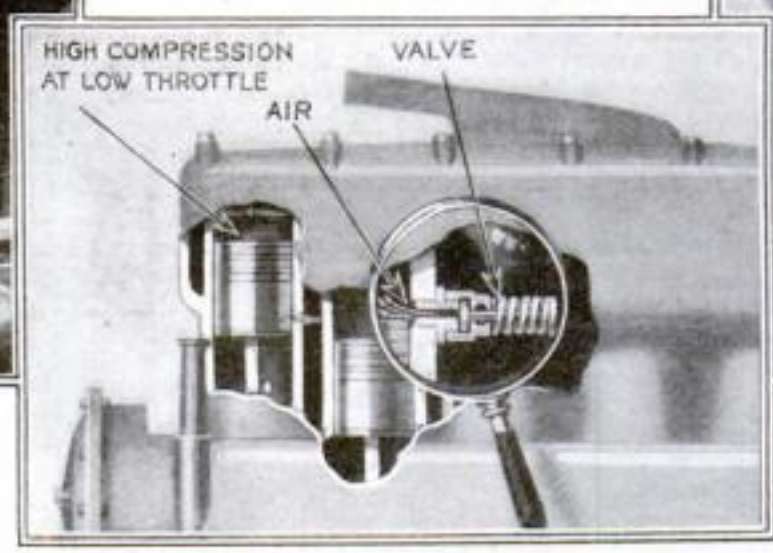


By the aid of this device even a physically weak person can quickly lift the heaviest spare wheel to its place in the rear of the car and fasten it securely with bolts to the carrier plate

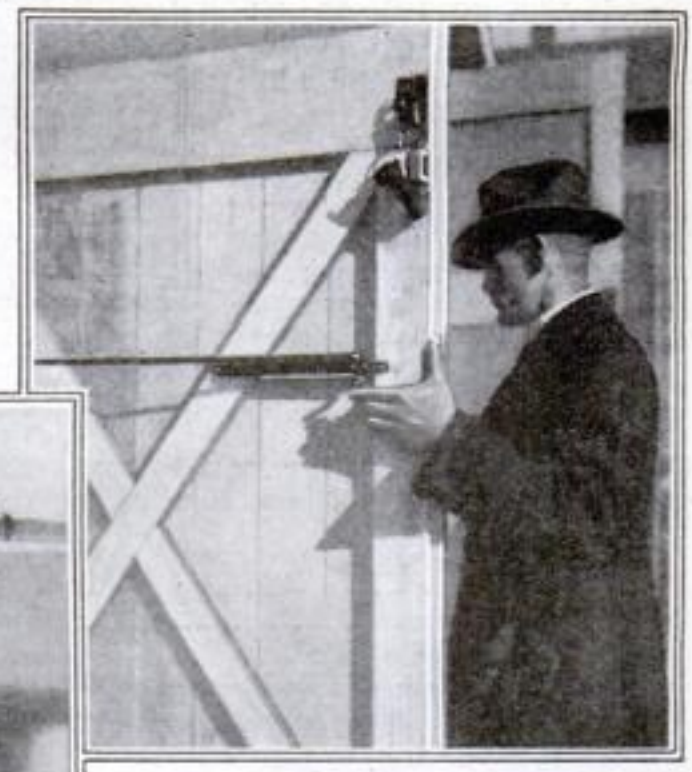


With this alternating current voltmeter almost instant connection may be made with the Ford magneto, whether the car is standing or running, and correct readings of the strength of the magneto may then be made

Hinged to the runningboard, this aluminum device serves the double purpose of a step plate and a suitcase holder. In the rim of the plate are cut eyes through which straps may be passed to hold the suitcase firmly, as above. The device is attached with screws



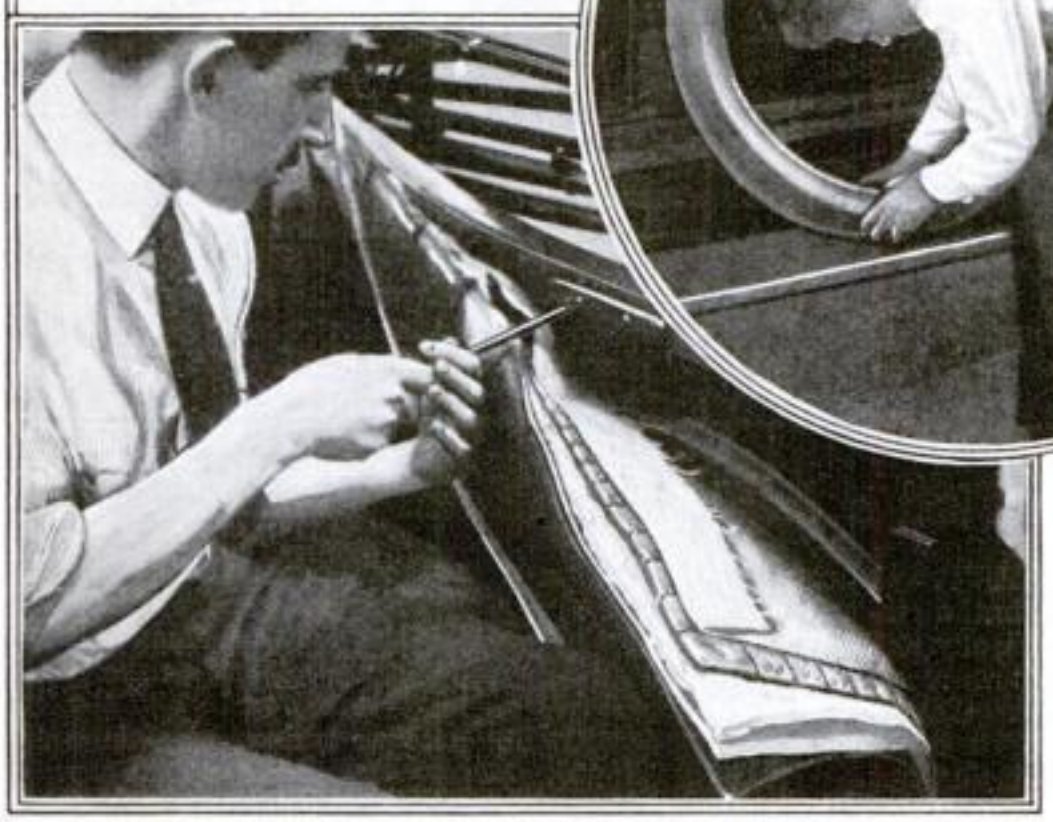
A spring-closed valve that is uncovered only when the piston reaches the bottom of its stroke. The air admitted gives higher compression when running with throttle partly opened



When the door of the garage is fully opened, the hook of this guard will slip into a notch and make it impossible for the door to swing shut from wind pressure. The catch is easily released for closing the garage door by lifting it with one finger

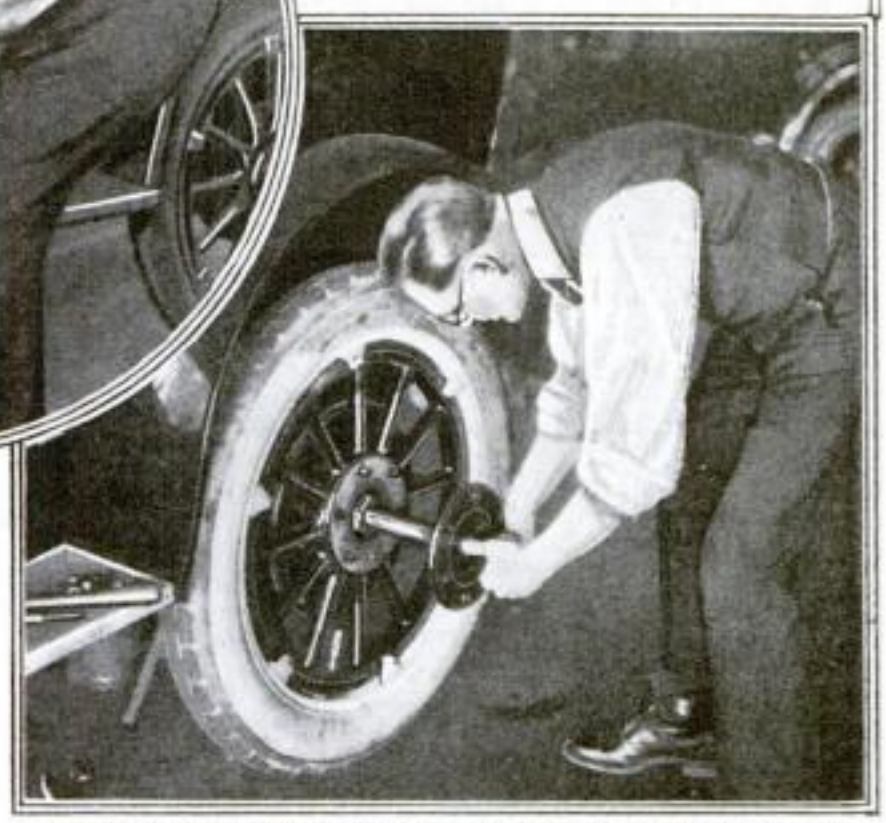
Keeping Your Car at 100 Per Cent Efficiency

DANGER, wasted money, lost time, and misspent energy all menace the motorist who neglects certain small but necessary adjustments and repairs to his car. A national authority on automobile repairs and maintenance explains in pictures on this page, each month, the easiest methods of keeping your car at 100 per cent efficiency

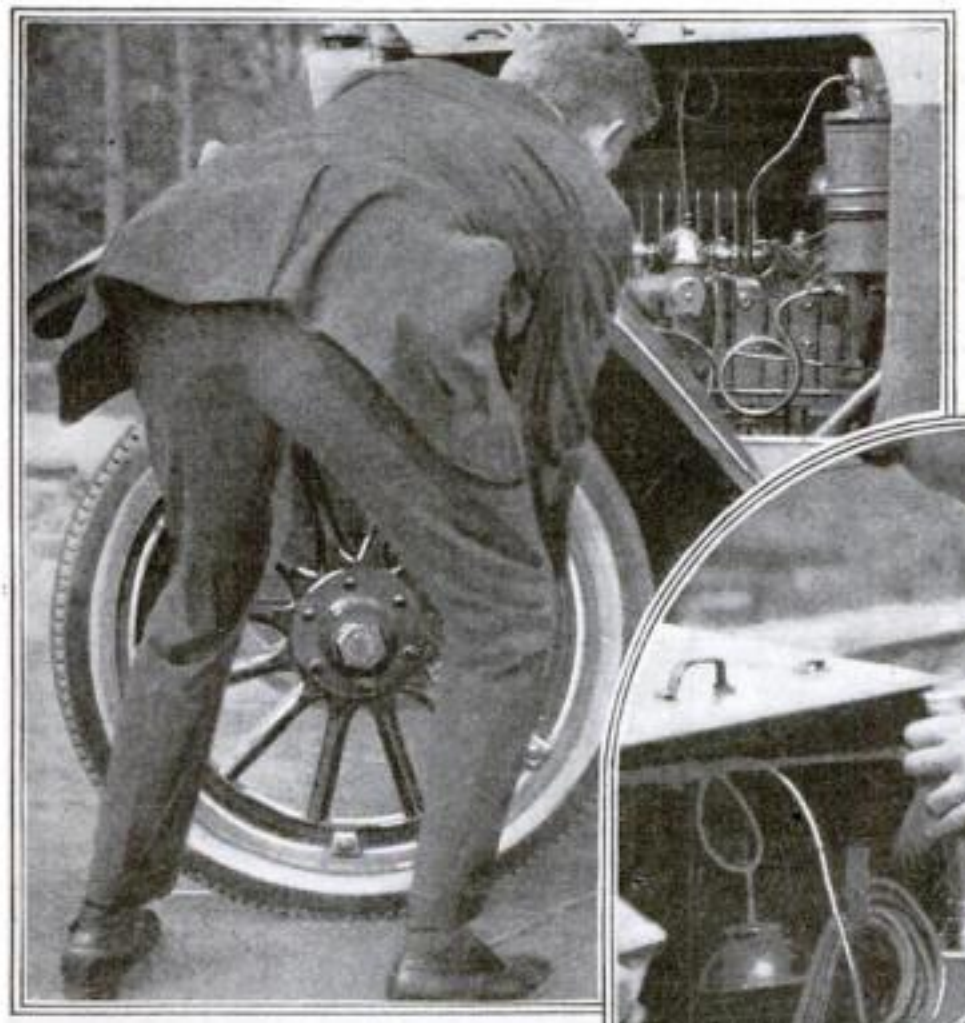


BEFORE repairs to door locks or top irons can be made or dents taken out of the metal body of the car, the upholstery must be carefully removed. The picture above shows how easily it can be done if proper care is exercised

IT IS a wise policy to examine the tires from time to time. Holes, defects in the fabric that may develop into blowouts, rim-cuts, or tube pinching may be detected before it is too late. Place the tire on the runningboard as shown at the left, and spreading it open with the hands make a careful inspection, revolving the tire a foot at a time

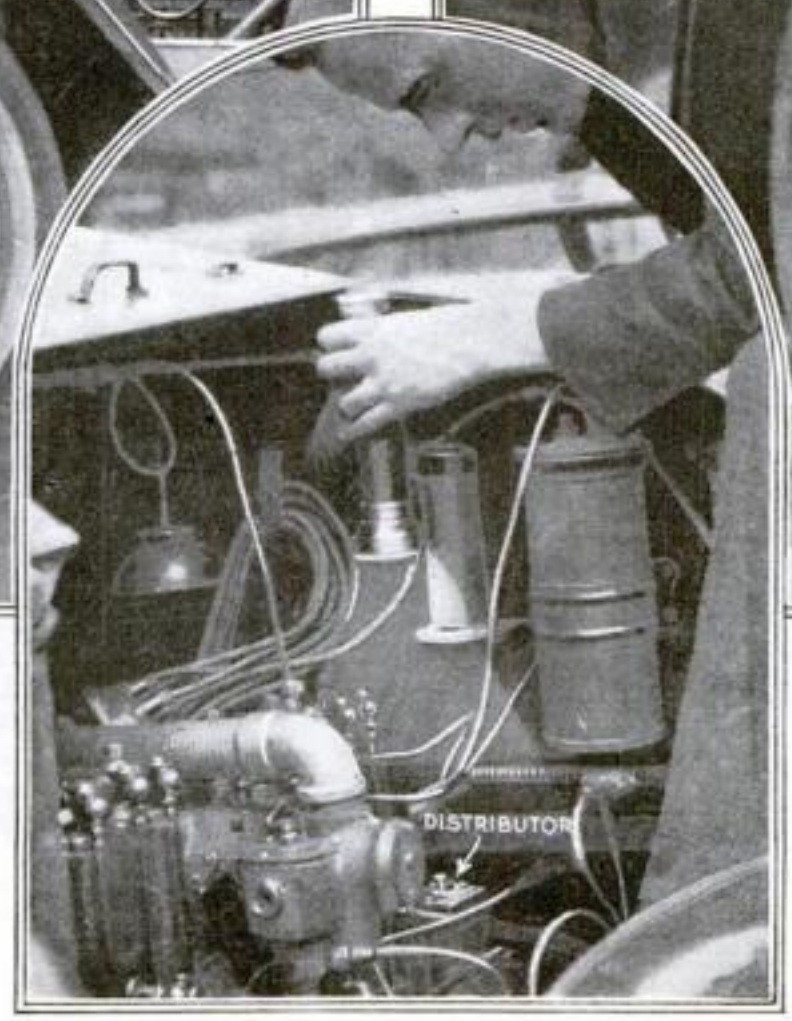


LEAKAGE of grease through the rear axle flange is quickly stopped by removing the nuts of the hub, pulling out the hub and axle shaft and fitting a gasket of heavy wrapping paper over it



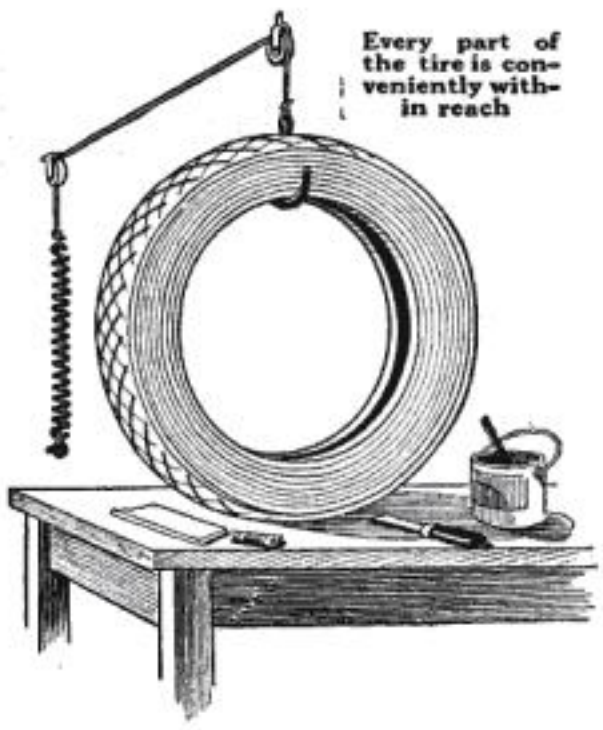
TO ADJUST the breaker points, place the gear lever in high and rotate the engine slowly forward or backward until the point of maximum opening is reached, then move the spark lever to the right position

THE adjusting of the breaker mechanism is difficult because it is usually impossible to obtain sufficient light. A pocket flash lamp is indispensable



WHEN the brakes are properly adjusted, they should be tight when set, but should not interfere with the movement of the wheel when off. Jack up the rear wheels and turn them by hand. They should spin freely. If they do not, the brake band is probably set too tightly and should be adjusted until the brakes no longer show a tendency to bind

Holding Tires in Position for Repairs



Every part of the tire is conveniently within reach

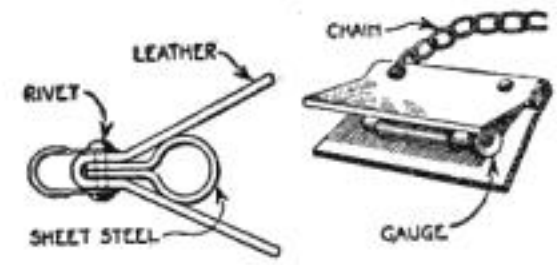
IN THE accompanying illustration a simple method is suggested for holding an automobile tire in an upright position on the bench while undergoing repairs.

Above the bench a hook is screwed in the ceiling for supporting a pulley. The hook should be so placed that when the tire is suspended by a rope passed over the pulley, it will be in the desired position. The rope, passing over the suspension pulley, is then passed over another pulley fastened to the wall and tied to one end of a coilspring, the other end of which is attached to a hook in the wall.

The weight of the tire will be enough to pull down the suspension hook until the tire rests on the bench. The tension of the spring should be strong enough to counterbalance the weight of the tire. When the tire is removed, the spring will draw the hook out of the way.—T. P. W.

Protecting the Tire Gage from Loss and Damage

SHOWN below is an attachment used by a service station to avoid the loss of and damage to the tire gage used by the customers of the place. It consists of a piece of heavy leather doubled over and riveted with a steel clip fastener about the



Leather flaps prevent damage when gage is dropped

tire gage and a long section of chain attaching it to the portable air compressor.

To use the tire gage the flexible leather is pushed back and the tire gage can be inserted between the wheel spokes and over the valve stem.—G. A. LUERS.

"Rusting Shut" a Small Crack

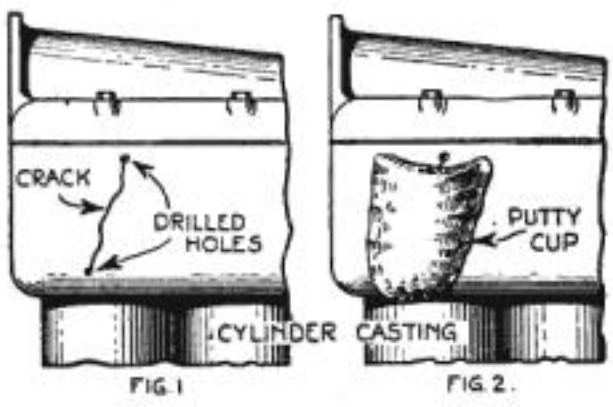


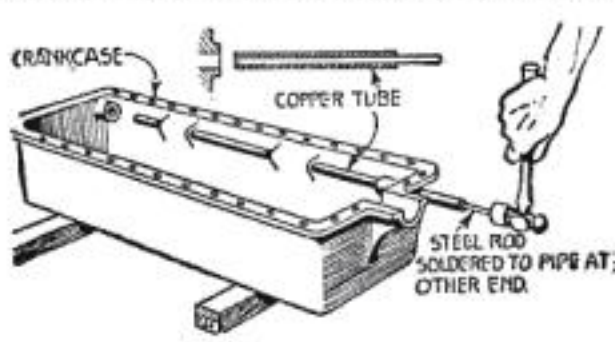
FIG. 1 FIG. 2.

IN THE midst of the threshing season a neighboring farmer found that a small crack in the cylinder casting of his tractor allowed the water to leak from the cooling system. He filed the edges of the crack until they were bright, drilled two holes in the jacket, one at each end of the crack, drove plugs into them, and filed the plugs off smooth.

Then he built a cup of putty around the crack and poured into it a solution of ¼ lb. of sal ammoniac dissolved in 1 qt. of water. When the crack was completely immersed, he let the solution stand for a time until the opening had "rusted" shut. Then he washed the solution thoroughly out of the cooling system.—ED. HENRY.

How to Insert New Oil Pipe in a Crankcase

WHEN inserting a new oil pipe in a crankcase, the easiest and quickest way to drive in the pipe is to fit a steel rod inside of it, soldering the end of the rod to



A steel rod stiffens the pipe

the pipe. By hammering on the rod, the pipe may quickly be driven into place. Then by applying a little heat, the solder is melted so that the rod can be withdrawn.—L. S. D.

To Find a Leak in a Metal Float

OCCASIONALLY the metal float in the carburetor becomes leaky and causes the carburetor to flood. If the float is shaken, the gasoline can be heard splashing on the inside, but it is often difficult to find the leak.

If the float is placed in a glass of very hot water, small bubbles will soon come from the leak. When the gasoline is heated, some of it evaporates and sets up a pressure within the float that causes the bubbles to escape. The opening should be carefully marked so that it can be found easily when it is to be repaired.

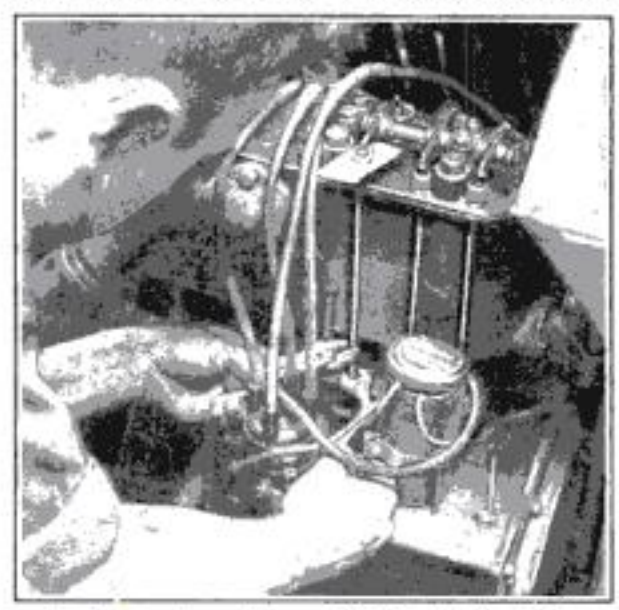
Next, the float should be punctured with some sharp instrument and all the gasoline drained. To make sure of getting out all the gasoline, it should be dried for some time in a warm oven or in the sun.

The next step is to prevent further leakage by soldering the puncture. Only a small amount of solder should be used, as a little difference in the weight of the float will be sure to cause trouble.—E. S. GIBBS.

GASOLINE will remove road tar when soft, and either lard or oleomargarine will soften the tar after it has begun to harden. To prevent damaging the varnish, remove tar as promptly as possible.

Adjusting Automobile Valves

IN ADJUSTING valves on an overhead valve motor, it is a good plan to determine the clearance by inserting a strip of



A piece of cardboard is inserted under rocker arm

thin cardboard under the rocker arm. Then adjust the valve stem until all excess clearance is taken up.—H. F. BLANCHARD.

How to Find the Trouble

(*Continued from page 69*)

and leakage of current, due to a visible or invisible crack in the distributor, are the main troubles.

Water on the spark plugs or distributor may provide a temporary short circuit for the high-tension current, and thus prevent the starting of the engine. The best remedy for wet wires is to place them in a warm spot, but not so hot as to injure the insulation.

An invisible crack in the distributor may prevent the running of the engine, since the high-tension current may leak through this crack rather than through the various wires to the spark plugs. Sometimes this leakage will only occur when the engine is extremely warm, in which case the engine may stop suddenly when very warm and start just as suddenly when it cools. The only remedy is a new distributor cap.

The distributor brush, of course, must be in place and must make good contact; interior of cap should be clean and dry.

Let's return, finally, to a consideration of the carburetor. You'll remember that if a few explosions can be coaxed from a balky engine after priming, it shows that the trouble is probably in the carburetor. If the carburetor happens to be equipped with a small jet for low speed running, and another for high speed, the clogging of the low speed jet will stall the engine. The remedy is to clean out the jet.

The Home Workshop

New and Useful Things to Make with Tools

How to Build an Electric Washing Machine

By Edwin J. Bachman

MOST women declare that of all the work they do around the house, washing the clothes is the hardest, and they dream of some day being the proud owner of an electric washing machine and looking like the immaculate ladies in the advertisements.

Why not, instead of waiting for that far-off day, build your wife, mother, or sister such a machine? I have made several, both power and hand models, at the nominal cost of $25. Owing to the chance of accident and the additional expense, I have used the hand operated wringer.

The machine described in this article is constructed mainly of cypress and galvanized sheet metal, although copper or zinc may be used in place of the steel.

What Lumber to Use

The tub sides should be sawed from sound lumber ⅞ or 1⅛ in. thick; the edges should be square and the different pieces all the same length. The lower boards should be fastened together with sprigs and after the curved line has been laid out, may be cut to shape on the bandsaw or by hand. Sawing the boards in this manner will insure a neat job when the sheet metal is nailed on. The mill work may be done at the planing mill where the lumber is secured, and should not cost more than five or six dollars. The sides may be assembled temporarily by laying them in position and nailing light strips across them to keep them from moving.

The galvanized steel comes in sheets 24 in. wide by 72 in. long. Cut off 48 in. to form the ends and curved bottom of the tub. Scribe a line ½ in. from the edge on the two long sides, and punch or drill holes 1 in. apart along the entire length. These holes should be slightly smaller than the nails to be used so they will fit tightly. Twopenny nails are suitable for fastening the metal.

The wooden sides should be set on edge on the floor or bench, so that the curved edges are upward. The wringer supports are placed in position between them and fastened with No. 10 screws 2½ in. long. Two light strips may be nailed higher up the sides so that the outside measurement at all points is 23⅞ in. A vertical line is drawn on each side, passing through the exact center, and another line is drawn across the exact center of the sheet steel. When applying the metal, these lines should correspond.

With the metal overhanging the wooden sides 1/16 in., start at the center line and nail it securely. Work both sides alternately, so that there will be no trouble caused by the metal's buckling. Remove the temporary strips as you approach them when nailing. After you have nailed the curved bottom, you will be surprised at the rigidity of the tub.

To Make the Tub Watertight

When the entire length has been nailed on, the ends should be bent over the wringer supports and fastened in the same manner. The 1/16-in. overlap is next peened over with a light hammer. This will make a joint that is absolutely watertight. The side boards are held in contact with each other so tightly that after water has once been in the tub, there will be no leakage whatever. The writer constructed a tub in this manner in 1918 that has not leaked to date, although it is in constant use.

This accomplished, lay the tub on its side and place two of the legs in position, the ends being flush with the top of tub. Secure these with wooden clamps or with several small nails, and drill ¼-in. holes through leg and tub. One hole is in the small strip at the top and two in each of the wider boards. For the fastening use 2¼ in. by ¼ in. carriage bolts, with the round head on the inside.

The Motor Shelf

Secure the legs on the other side in the same manner and stand tub upright. Two pieces of ⅞ by 2 in. stock, 26 in. long, are fastened to the inside of legs to support the motor shelf. The drawing shows this member with an area as large as the floor space of the machine. This is not entirely necessary, as the motor occupies very little room and the countershaft is not mounted thereon, but it will add to the rigidity of the machine. The countershaft bearings may be bolted to the legs before drilling to receive the bushings. By measuring equal distances from the floor to the center of each, the shaft can be kept perfectly level.

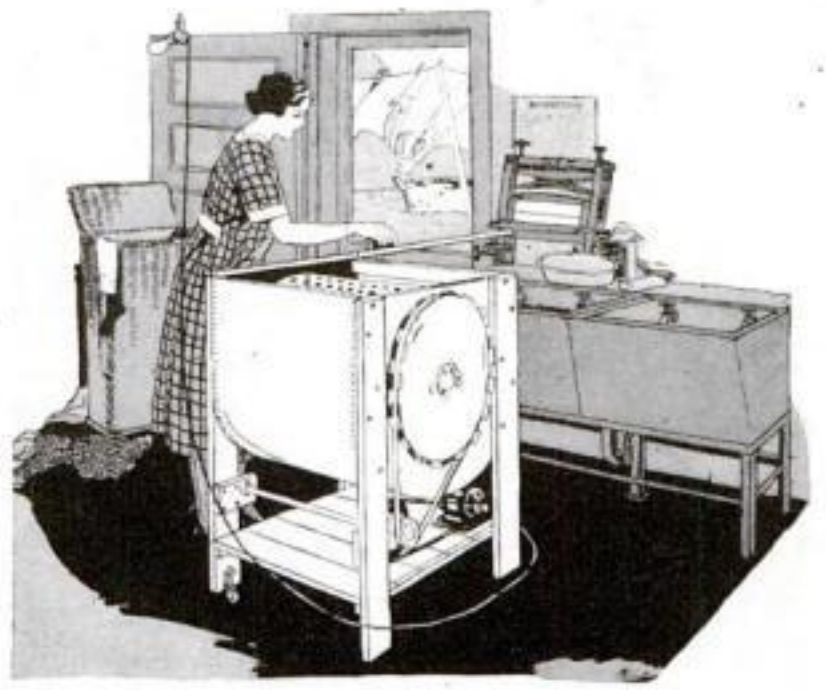
A rotor with short paddles is often used in large laundry washers and many household type machines, and these are equipped with a reversing mechanism, so that the clothes will not roll up in a ball. Few home workers are prepared to build so complicated a mechanism, so we can make the rotor in a simpler manner.

One way is to make a rotor with a wooden partition. In this type the wash is divided and placed on each side of the board and the lid of the rotor opens directly over the edge so as to make all parts accessible. The board is drilled full of 1-in. holes 1 in. apart and is held in place by two cleats fastened to each rotor head. A heavy galvanized wire netting of about ⅜-in. mesh is used to cover the rotor, except where the wooden lid is fastened on.

Another method, which is illustrated in the rotor detail on page 78, makes a very strong barrel. The short paddle in the center has the advantage of not rolling the wash into a ball. The curved sides are sheet metal and are fastened in the same manner as the bottom and sides of the tub. The straight sides are wooden ones, being made easily detachable, and are drilled full of 1-in. holes to allow the water to flow freely.

The lid for the machine is a square frame, 26 in. on a side, made of ⅞ in. by 3 in.

The One Necessary Labor-Saver



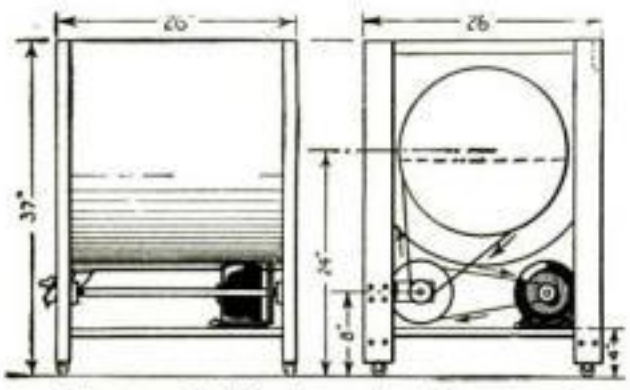
IN TENS of thousands of homes the washing machine has become the most essential labor saving appliance. No great progress was made in relieving the drudgery of washing until its invention. It is cost alone that keeps electric washing machines from being used universally. For the man who is handy with his tools, however, the cost of making an electric washing machine is nominal.

Mr. Bachman, the author of the accompanying article, has built several types of inexpensive washing machines, both hand operated and electric, that have worked well, and his instructions, if carefully followed, should insure satisfactory results.

For those readers who wish for more complete details, a larger drawing, and bill of materials, the Home Workshop Department has prepared a blueprint that will be sent upon receipt of 25 cents. A coupon for use in ordering it and other blueprints in the Home Workshop series will be found on another page.

strips. On this is nailed centrally a 24-in. square of the sheet metal. This will allow the wooden frame to project 1 in. all around, eliminating the danger of cutting oneself on the metal edge. The cover is shown hinged to the tub, but the hinges may be omitted and the lid removed entirely if preferred.

The simplest way of providing a drain is to drill a 1-in. hole in the wooden tub



Front and side views, showing general dimensions

side opposite the drive and close to the bottom, and fit it with a tapered wooden plug. This was the standard practice for a long time. Lately, however, the plug has been replaced with a metal faucet. The reader may use his own judgment in providing an outlet.

The countershaft is a piece of ¾-in. cold rolled stock, 27 in. long. Two grooved pulleys, one 6 in. and the other 3 in. in diameter, are needed to fit the countershaft. They should be provided with set screws.

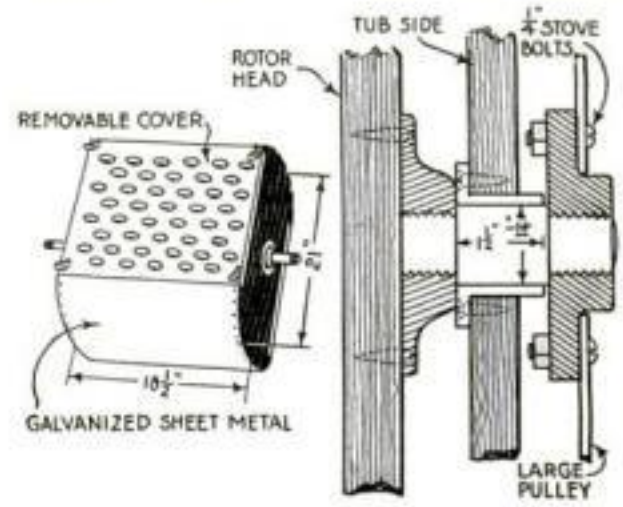
The motor may be a standard 1/6 or ¼ hp., such as those regularly advertised at prices ranging from $10 to $15. It must be fitted with a 1½-in. grooved pulley.

To drive the barrel, the ordinary 18-in. grooved or flat pulley is hardly positive enough. A six-to-one chain drive could be substituted here, but the purpose of this article is to show how the machine can be made at home, and few amateurs have shops equipped for making a chain drive. Instead, with a beam compass draw a 20-in. circle on No. 18 gage sheet steel and then an 18-in. circle concentric with the first one. After cutting out the larger one with a pair of heavy shears, divide the outside edge into an equal number of sections about 2 in. long. With a chisel or shears make a 1-in. gash at each mark. This gash should go to the 18-in. circle and no farther. With a pair of heavy pliers, bend the sections alternately to 45 degrees on either side of the center line. The gashed edges should be slightly rounded so the belt will not be cut. With a ⅜-in. or ½-in. round belt, zigzagging along the circumference, we have a drive that is positive even if the belt should sag.

For the Main Shaft

The large pulley may be riveted or bolted to the flanged shaft. A smaller idler may be used to keep the belt in good contact with the small pulley.

The main shaft, which is shown in detail, has a thread cut on one end to fit the tapped hole in the rotor. This drives in the same manner as the faceplate on a lathe, and permits the barrel to be removed easily. A short flanged shaft is fastened to the opposite end of the rotor and runs in a half bearing. It is held in place by a simple latch. A guard is necessary over the belts and pulleys. If a professional finish is desired, it is well to incase the machine in metal. When enameled, the



The rotor and detail of its shaft

washer will be a household utility you will be proud to own.

If you wish more complete working details of this washer and a bill of materials, send 25 cents for Blueprint No. 12.

Photographic Enlargements Used as Advertising Signs

SIGNS suitable for window displays and other commercial purposes can be made by using photographic enlargements of small printed cards or typewriting. A Washington, D. C., photographer recently made a sign 12 by 24 in. from a 2 by 4 in. card. When only one sign is to be made, this photographic process is probably as reasonable as any other.—A. G. L.

Learn Wireless Code with This Homemade Transmitter

By J. E. Pettibone

EVERY one who makes or buys a radio receiving set soon becomes curious to read the code messages that he can tune in at any time of the day or night. These messages, he quickly learns from other more experienced radio fans, are often most interesting—news despatches, witty interchanges between amateurs, messages between ships and shore stations, army and navy despatches, and all kinds of wireless traffic. These messages keep many a radio "ham" up long after the regular broadcasting programs have shut off for the night, because they are frequently as entertaining as the radio-phone programs.

To enjoy them, however, it is necessary to master the code, and that is not so easy. It is like a foreign language in that it is much easier to learn to send the dots and

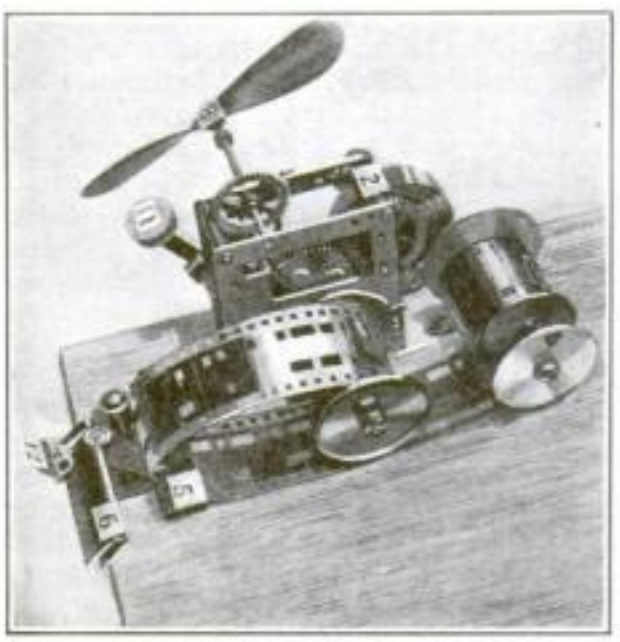


Fig. 1—General view of the automatic telegraph sender

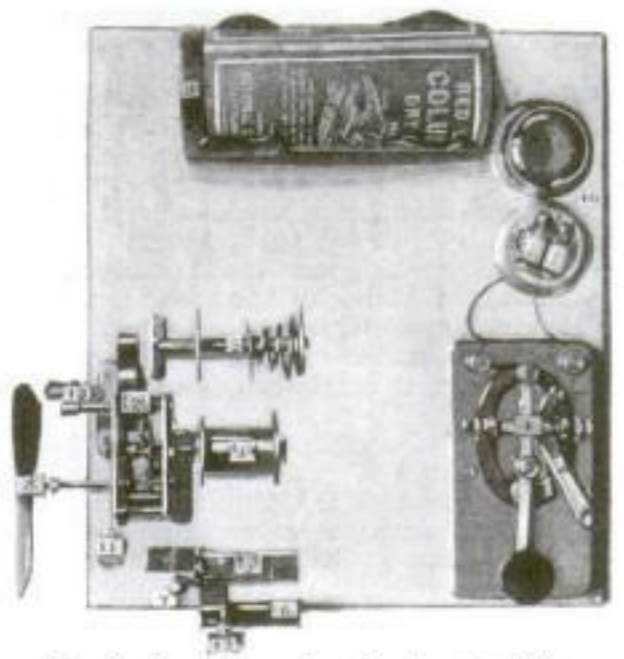


Fig. 2—Top view, showing transmitter, battery, buzzer, and key

dashes than to read them. One good way to learn is to make an automatic telegraph transmitter that will send code messages at varying rates of speed. Such a device is the one illustrated. It is practical and one that can be made by almost any one who is mechanic enough to construct a radio set. It has the advantages of being both efficient and cheap, and any number of messages may be prepared quickly for use in connection with it.

The apparatus was made mainly of pieces I had at hand in my own workshop. The operation of the machine is along the lines of a player piano. Suitable holes are punched in a length of old motion picture film, No. 17, Fig. 3, which is passed over the rollers in such a way that contact is made through the holes. It will be seen that the film has two rows of holes, so that if contact is made through both sets at the same time, one contact piece, No. 12, Figs. 1, 2, and 3, being connected with one buzzer, No. 10, and a similar contact piece being connected with another buzzer, practice in reading signals through interference may be had. In that case, both buzzers should have slightly different tones.

The old film may be obtained at a nominal price from almost any place where developing is done. It is wound on a holder, No. 3, Fig. 2, made from a piece of ¼-in. brass tube bent into an inverted L shape. Retaining disks cut from aluminum or other sheet metal are provided on this spindle. The outer disk is held in place by a thumbscrew so that it may be removed readily. The distance between the disks is somewhat greater than the width of the film, the additional space being taken up

(Continued on page 114)

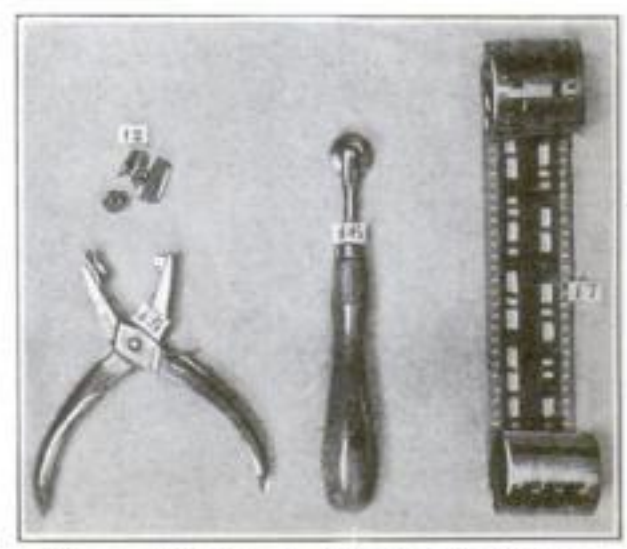


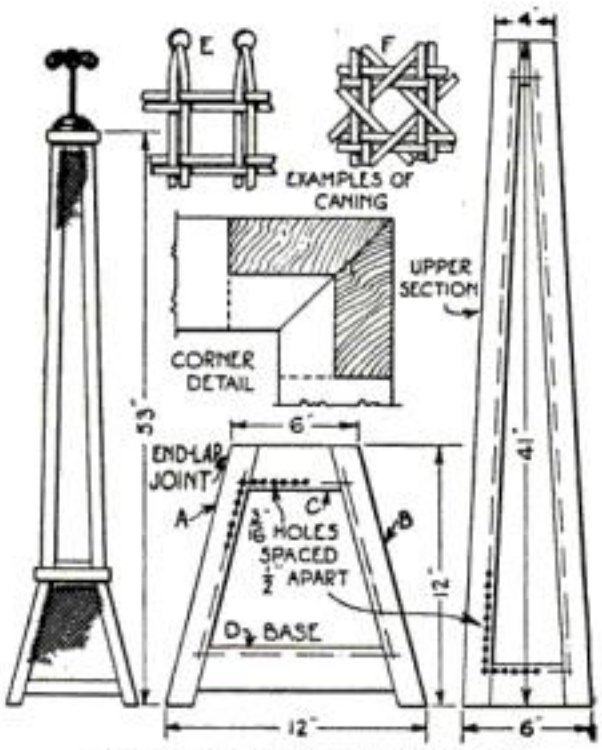
Fig. 3—The punch, marking wheel, perforated film, and contact piece

This Decorative Floor Lamp with Caned Pedestal Can Be Made with Few Tools

PROPER lighting contributes much to the comfort, charm, and individuality of a living room at night. Poorly placed lighting fixtures of crude design, throwing either too much or too little illumination, will counteract the effect of furnishings that are in the best of taste. But even glaring and inartistic lighting can be controlled and improved by the use of well-designed floor and table lamps; and of those varieties that can be made with the tools available in the average home workshop, few floor lamps are more attractive than this one with its caned pedestal.—THE EDITOR.

By Herbert A. Mincher

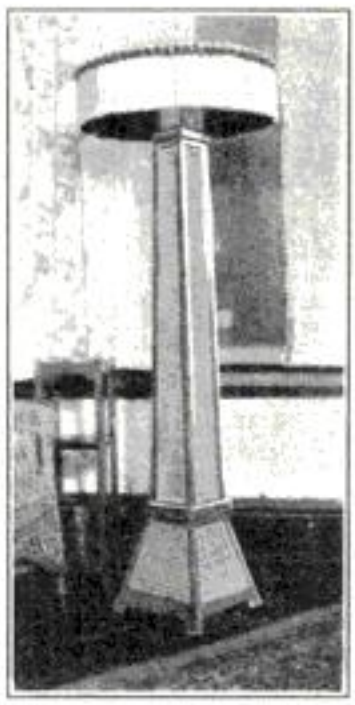
BEFORE beginning the construction of this lampstand, it is best to make a frame or pattern for the upper and lower sections. This will make it easier to obtain the correct angles and good, tight joints. The frames can be made of any scrap material at hand, and should be of the size and shape shown in the accompanying details.



Details of the frame and caning

In making the base section four frames will be required. First cut the upright pieces, *A* and *B*, to fit in the pattern. Then lay out pieces *C* and *D*, so as to make end lap joints with pieces *A* and *B*. When the joints have been neatly fitted, glue them and nail them with small brads. Then the frames are ready to be drilled with 3/16-in. holes, approximately ½ in. apart, center to center, as shown.

The four frames for the upper section are made in the same manner, with the same type of joint, and are similarly drilled.



The lamp complete with shade

The next step is to cane these sections. This is done at this stage because it would be impracticable to do the caning after the pedestal was assembled. No one need hesitate to attempt the caning, because this is very much easier to do than it looks. It requires only a little patience and care, and the finished weave or pattern is certain to be much more regular and attractive than a beginner in caning would expect. Caning does not, indeed, demand the practice or skill required in woodwork or finishing.

To make the cane flexible and easy to work with, and to keep it from breaking, it should be soaked in water beforehand and kept well dampened throughout the caning process. First, starting at the center hole at the top and the center hole at the bottom, weave two strands of cane vertically through each hole in the top and bottom members of the frame being caned. It is very important that these should not be drawn too tightly or it will be difficult to push through the fifth and sixth strands of cane.

Weaving Horizontally

The next strands are woven in a horizontal direction, alternately over and under each of the vertical strands. The caning will now appear as in detail *E*, forming a series of parallel vertical and horizontal lines with open squares between.

The next strands, which are single, run diagonally, from the lower left-hand corner to the upper right side. They go under the vertical pairs and over the horizontal pairs immediately to the right of and above the vertical ones, as shown in detail *F*. The diagonal lines of cane that complete the operation go from the lower right-hand corner to the upper left-hand side and always pass over vertical groups and under horizontal ones.

The cane is fastened at the beginning and end, and wherever else necessary, by the use of small wooden plugs driven into the holes. When a new length of cane is added, the joint is, of course, made at a hole. It is well to make several wooden plugs that can be stuck in temporarily here and there on top to hold the cane in place while working. It will be found that after the last strand has been woven through, the under layers are bound tightly.

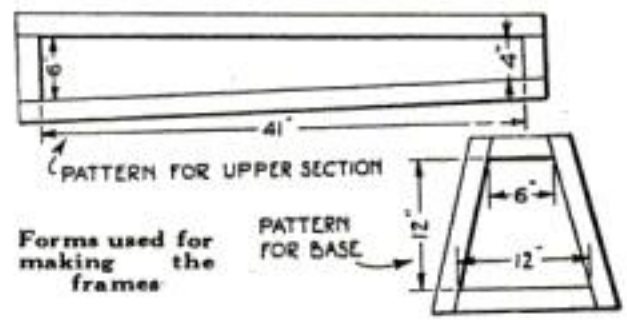
A little ingenuity will solve any problems in weaving that arise in this or any other piece of ordinary cane work.

A length of binding cane, wide enough to cover the holes, is laid along over the holes and is fastened with a piece of fine cane that is run up through every other hole, passed over the binding strips and down through the same hole.

After the sections have been caned, they are assembled. They should be glued together and clamped until dry, care being taken that the joints are tight and the sections square.

When they are dry, a piece of scrap lumber is fastened in the smaller end of the lower section and the lower end of the upper section, and a hole is bored in the center to take an ordinary ⅜-in. pipe, which serves as a conduit for the wiring. Two holes for ¼-in. or smaller bolts also are drilled. These bolts hold the upper and lower sections together.

A piece of oak, approximately 4 in. square, fitted on top of the upper section, and 4 pieces of ½ in. by 1 in. oak are bevelled to fit around this piece, forming a frame to trim the cap so that no end grain will show. A hole for the ⅜-in. pipe is drilled through this cap. The joint between the upper and lower sections is also covered with trimming pieces ½ by 1 in.



Forms used for making the frames

A piece of ⅜-in. pipe is then run down through the center, and the light socket and stand are screwed on top of it. The pipe should be so cut that when the light socket is screwed on, it will draw up tight. The coupling on the end is used as a nut.

The lamp is then ready for varnishing. Stain of any color desired can be used.

The stand is intended for a large shade of the variety shown, although almost any style of shade of any material may be used.

Tools and Materials Needed for Making the Lampstand:

THE tools required are:

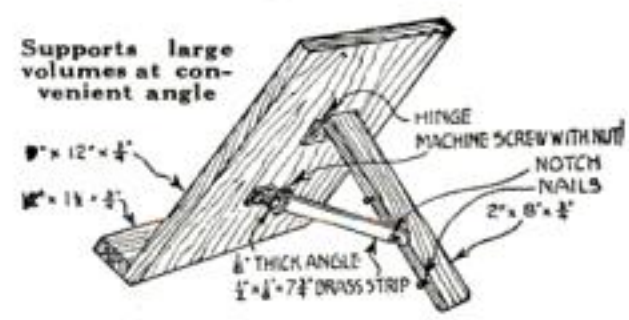
Hammer	½-in. chisel
Saw	Plane
Square	Small miter box
Brace and	3/16-in. wood bit

The materials required are:

36 ft. ¾ in. by 1¾ in. oak, beveled 45 degrees on one edge, for vertical members
9 ft. ¾ in. by 2 in. oak for horizontal members
4 ft. ½ in. by 1 in. oak for trim
1 piece oak ¾ in. or ⅞ in. by 4 in. for top
1000 ft. superfine cane, 50 ft. binding cane
1 length of ¾-in. pipe for wiring conduit
3-way electric socket and stand
Lamp cord
2 ¼-in. or smaller bolts, 1½ in. long

Easily Made Adjustable Bookrest

WHEN reading a large volume or making many notes from a book, an adjustable rest such as is illustrated will add considerably to one's comfort. The angle is changed by adjusting the hinged leg by means of a notched brass strap, which engages nails that project from the edge of the leg.—FRANK HARAZIM.



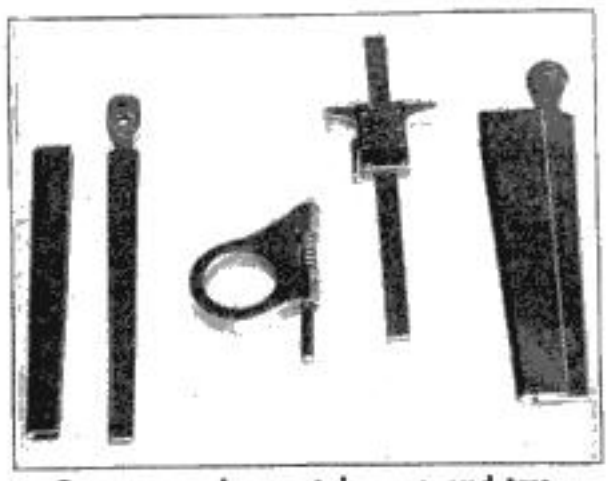
THE Home Workshop is continued on page 90. It contains nearly half a hundred more useful and money-saving suggestions for men who like to work with tools.

Better Shop Methods

How Expert Mechanics Save Time and Labor

Four Useful Tools that Any Machinist Can Make Easily

Boring Chuck, Center Punch, Taper and Scratch Gages



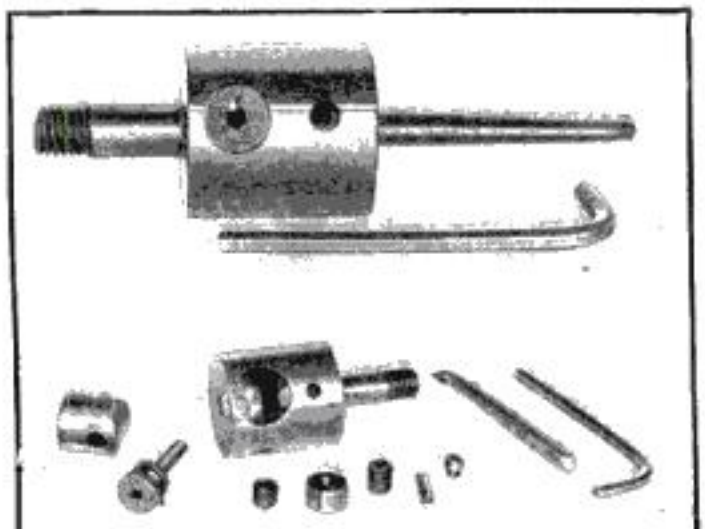
Center punch, scratch gage and two sizes of taper gages

MACHINISTS who are on the lookout for time and labor saving tools to add to their tool kits will find useful suggestions in the accompanying drawings, which give complete details for an eccentric boring chuck, a milling machine center punch, a taper gage, and a scratch gage.

The features of the boring chuck are its simplicity, few parts, and range of tool movement for the size of the chuck. The 5/8-in. and 7/8-in. holes were counterbored and reamed with a machine reamer on a milling machine, using the dividing head. The counterbores were used by Mr. S. L. Roberts, who designed and made the chuck, so that the two holes would be as nearly parallel as possible without the necessity of boring them at all.

It is interesting to note that Mr. Roberts uses a set of counterbores all of which are from .001 to .003 in. under standard reamer sizes and finds them serviceable in work requiring dowel pins and the like. In shops where there is no complete set of letter size drills, these counterbores are handy because it is obviously better to ream out .003 in. than perhaps nearly .015, as in the latter case the hole is more apt to be oversize.

The follower or nut (7), after a 1/4-20 left-hand tap has been run in it, is cut with a 1/16-in. saw as shown and the parts on each side of the slot are sprung together. A hole is then taper reamed for a No. 1 taper pin, which is pressed in lightly so as to expand the nut. Should there be any wear on the nut or screw, the pin may be driven out a trifle and the nut closed so as to take up any lost motion in nut and screw. No adjustment, however, has so far been required of the original chuck, although it has been subjected to considerable hard usage. The nut and screw are tool steel, No. 6 being hardened only to the threads. The 3/16-in. setscrew (6) also is hardened.



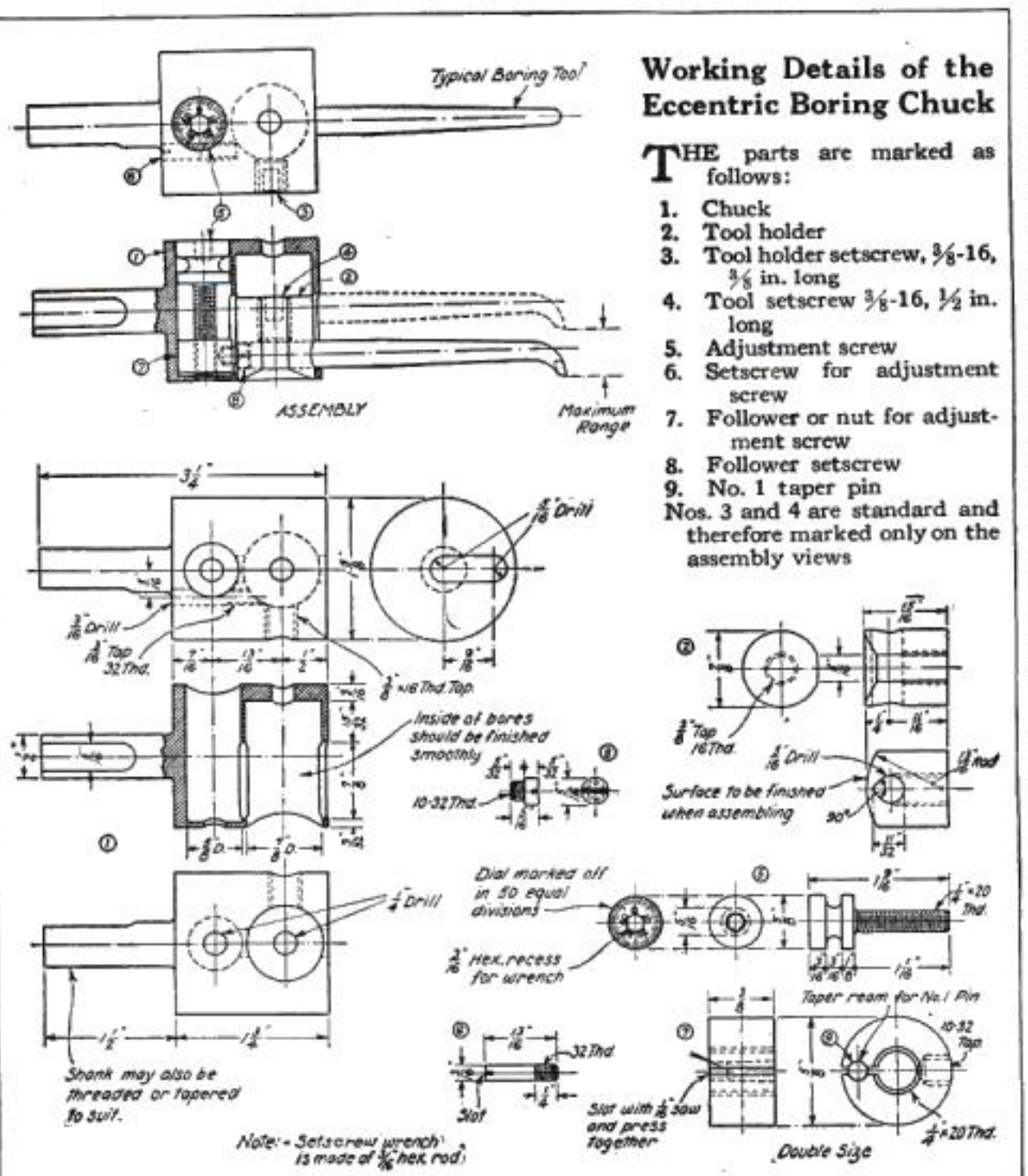
The finished chuck and its parts

The milling machine center punch is used for laying out centers on work quickly and accurately with the aid of a milling machine; it also can be used for scribing lines. The body is of mild tool steel and the plunger is made of a 3/16-in. drill rod. A heavier plunger may be used if desired. The 1-in. hole fits over the milling machine arbor, and if a smaller arbor is used, it can be built up with rings. The hardened point of the plunger should be a close fit in the holder, the holes in which should be perfectly parallel with the sides.

In use the plunger is fastened on the arbor just as a cutter, the plunger being approximately vertical. Fasten the work on the milling machine table and bring it to within 1/4 in. of the plunger point. Locate the first center and tap the punch. Move the table to the next position, using lateral and cross feed dials for distances in either direction. This will be found accurate enough for ordinary work and is a very speedy method.

The taper gage, which can be made in various sizes to suit the sizes of work ordinarily handled, is useful for finding the taper for every foot in the spindles of lathes, milling machines, drill presses, lathe tailstocks, di-

(Continued on page 88)



Working Details of the Eccentric Boring Chuck

THE parts are marked as follows:

1. Chuck
2. Tool holder
3. Tool holder setscrew, 3/8-16, 3/8 in. long
4. Tool setscrew 3/8-16, 1/2 in. long
5. Adjustment screw
6. Setscrew for adjustment screw
7. Follower or nut for adjustment screw
8. Follower setscrew
9. No. 1 taper pin

Nos. 3 and 4 are standard and therefore marked only on the assembly views

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References.....

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Handy Chart Quickly Gives I-Beam Facts

By W. F. Schaphorst

THIS ready-reference chart tells all about I-beams almost at a glance. It serves more quickly than a table for solving many problems of frequent occurrence in construction work and gives close results for regular standard beams. For "special" beams, however, caution should be exercised in applying it.

I-beams are much used and certainly will be used more and more for holding concentrated as well as uniformly distributed loads. The I-beam is the lightest and most economical steel beam for most purposes.

Inasmuch as a concentrated load requires the *largest* beam for a given load, this chart is based upon concentrated loads for the sake of safety.

The wavy lines with arrows running to the vertical chart lines show at a glance just what each chart column means. Thus, Column A gives the length of the span in feet and includes all lengths from 1 ft. to 40 ft. Column B gives the weight of the I-beam in pounds per foot, and includes all weights from 1 lb. to 200 lbs. Column D gives the safe load of the I-beam in pounds and varies from 400 to 30,000 lbs. Column E gives the depth of beam in inches from 1 to 10, as shown.

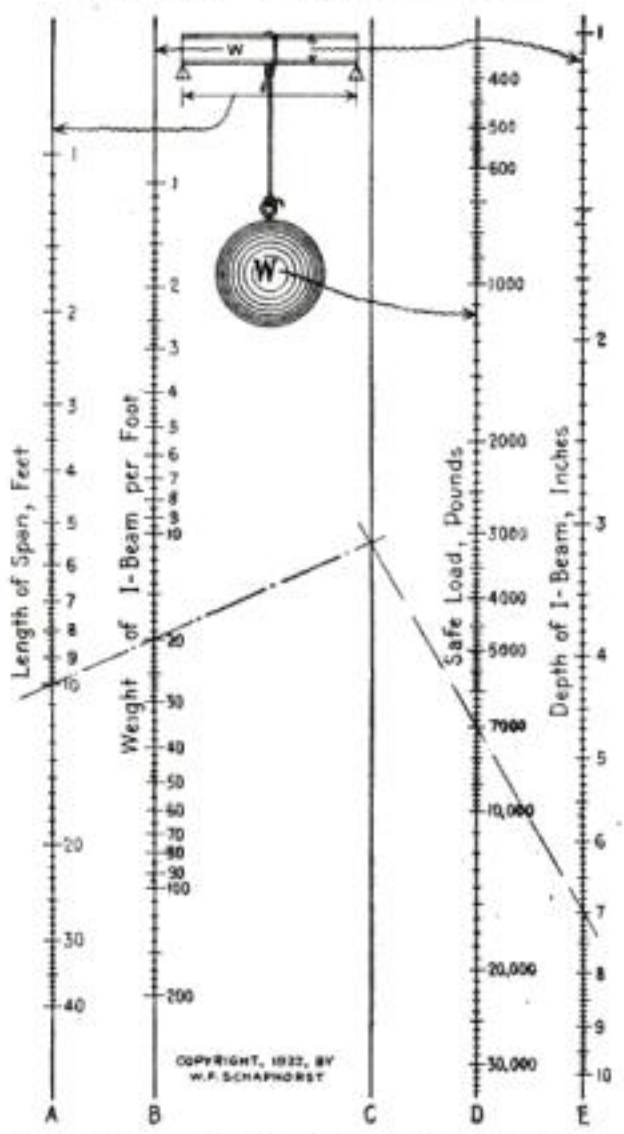
Let us suppose that a weight of 4000 lbs. must be lifted. A 7-in. I-beam weighing 240 lbs. is available. It is 12 ft. long and therefore weighs 20 lb. per ft. The minimum distance between supports that can be obtained for the lifting operation is 10 ft. Can the I-beam lift the 4000-lb. load?

The dotted lines drawn across the chart show how the problem is solved by means of the chart. Run a straight line through the 10 ft. (Column A) and the 20 lb. (Column B) and locate the intersection in Column C. Then from the intersection in Column C run over to the 7 in. (Column E). The intersection through Column D shows that the I-beam will support 7000 lbs. Since the load to be lifted is only 4000 pounds, the beam is amply strong. In fact, the reader will see that a 4-in. I-beam, all other conditions being the same, would safely support the load of 4000 lbs.

Similarly, it is easy to ascertain the maximum allowable span when the factors in Columns B, D, and E are known. Or, the necessary weight per ft. of I-beam may be determined when the factors in Columns A, D and E are known. Lastly, the depth of beam is determinable when the factors in Columns A, B and D are known.

For loads that are "uniformly distributed"—not concentrated—the safe loads in Column D may be multiplied by two. Thus, the above described beam will support a uniformly distributed load of 14,000 lbs., or 1400 lbs. a running foot.

For Your Shop Notebook



This chart saves consulting tables and making calculations in regard to I-beams. Given any three facts about a beam, the fourth can be ascertained graphically by two lines drawn through the known points to intersect in C, as shown

Cotter Pin and Staple Puller for the Hammer

THE home mechanic, the garage repair man and the carpenter, when working on certain jobs, will find this cotter pin and staple puller attachment a useful addition to his hammer.

A piece of stub steel is squared up at one end; the other end is rounded and threaded for a nut. The squared end is tapered down to a round point and bent as shown and a reverse taper is filed on the short end of the bend where it meets the round section. The piece is then hardened and drawn to a dark brown color, which removes the temper and leaves the steel tough and stiff.

The hammer head is then drilled and the side of the hole is filed square to fit the bent tang, which is inserted and drawn up tight by the nut on the other side. The threaded nut is filed off smooth and the threads slightly battered, in order to prevent the nut loosening.

The safest way to use the tang is to have it turned downward, as shown, although most mechanics would prefer it turned up, in which position it is somewhat easier to use.—C. H. S.

A hardened steel tang is fastened to the side of the hammer

Choosing Steel for Gages

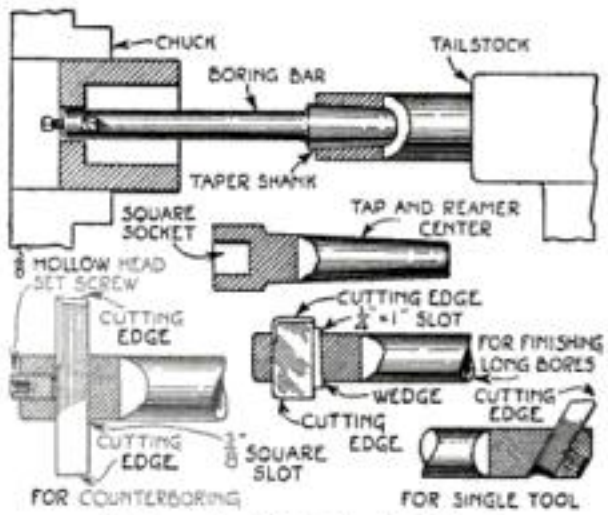
THE selection of material for gages depends largely on the gage to be made and its use. For flat or profile gages and templates a good grade of low carbon or machine steel can be used. Plug and ring gages require a higher grade of tool steel. Steel for thread gages should be selected with great care. A fine, close grained steel, should be chosen.

How to Make and Use Tailstock Boring Bars

MOST machinists and lathe operators look upon the tailstock of a lathe as a part of the machine designed only for the holding of the dead center, drills and reamers. The tailstock will save many hours of needless time and labor and make for better work and bigger production if full use is made of it for boring. How often do we see a mechanic using a slim boring tool, set up in the toolpost of the carriage, taking cut after cut from a cored hole in a fruitless endeavor to get the hole true?

Take, for example, bronze bushings, cast in halves and sweated together. These invariably have hard and soft spots; the hard spots shove the tool away so that unless the hole is reamed in finishing, the workman can bore away for hours trying to get a straight hole to accurate size.

On just such a bronze bushing job, the writer was able to speed up his production 50 per cent by using the slim, long boring bar illustrated. It was fitted with a broad



Boring tools for the tailstock

double cutter, held with a steel wedge key. The bushings were roughed quickly to within a few hundredths of an inch of size, and the double cutter then finished them accurately to size and perfectly straight. The bar fits into the No. 3 socket of the tailstock spindle and is fed through the bore by hand feed, the width of the cutting edge being sufficient always to overlap any unevenness in the feeding.

For the rapid counterboring of holes, the single sided tool is slow compared with a double cutting 3/8- or 1/2-in. high speed tool bit, placed centrally in the end of a stout boring bar held in the tailstock. With the single tool, many cuts must be taken, but with the double cutter, one cut is usually sufficient.

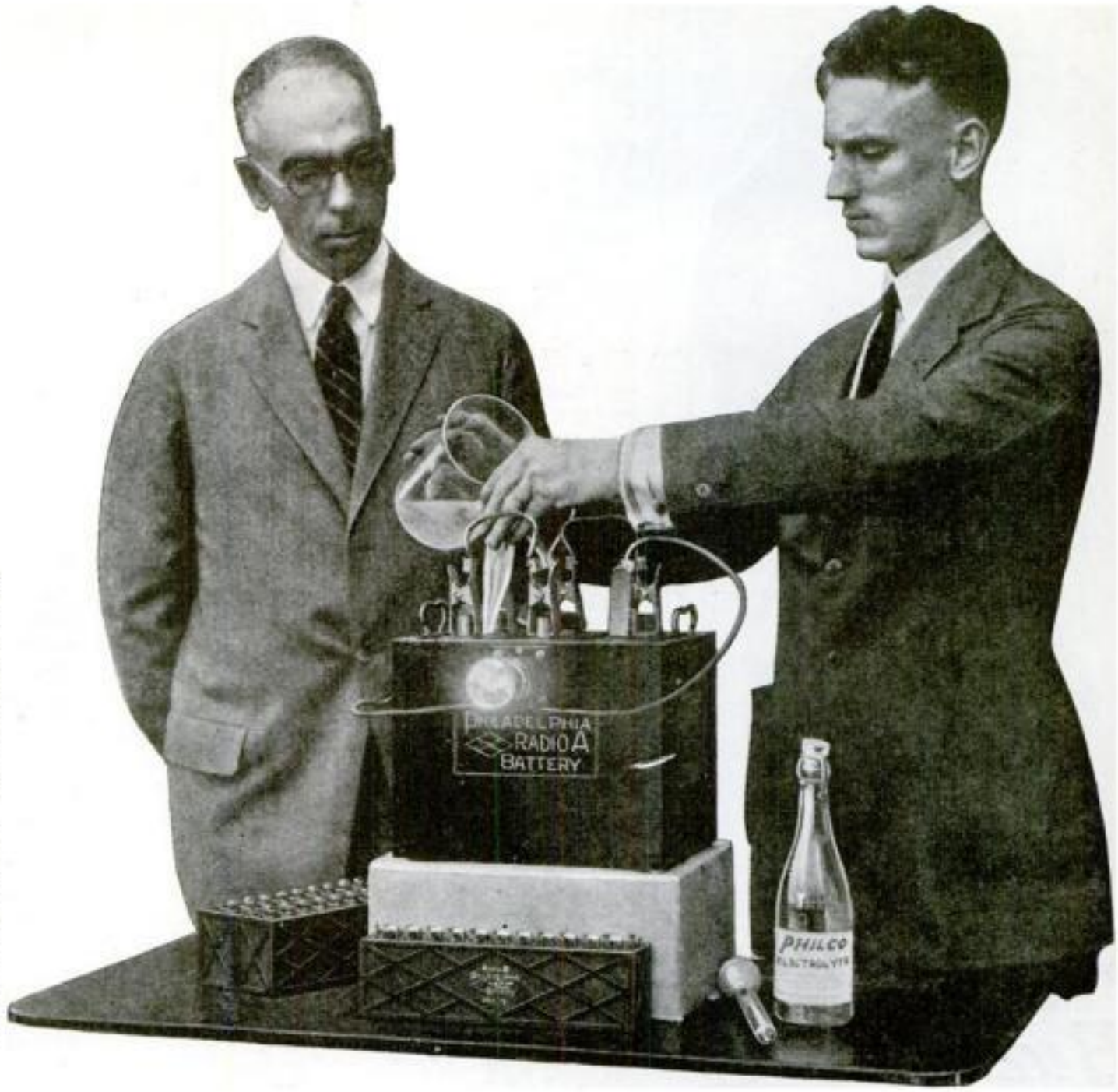
The tailstock is admirably suited for holding a heavy bar and even for single-sided tooling purposes is ideal, as its rigidity prevents any springing away of the tool from the cut.

A good bar for general use is the one with the slantwise tool slot on a 30-degree angle. This style of bar should be made up in several sizes.

The advantage of bars with the square tool bit slot lies in the fact that tools are easily made by mechanics themselves by grinding self-hardening tool steel.

Many a bore of an odd size, for which there was no reamer handy, has been finished up perfectly true and to size by the writer with double cutters made of square bit stock.—J. V.

THE weight of sheet iron can be computed by multiplying the thickness by 40. This gives the weight in pounds a square foot.



Engineers of the Philadelphia Storage Battery Company demonstrating to an assemblage of battery experts at Atlantic City the revolutionary features of the new Philco Radio Batteries equipped with "Philco Process Plates". A Philco Radio "A" Battery, assembled in full view of the audience, and without initial charging, developed full power on the pouring in of the Philco electrolyte—a history-making achievement. The Philco Radio "B" Battery is shown in the foreground.

A history-making achievement in battery engineering

Now—for the first time in history—you can equip your radio with batteries *born the day they're first used*—storage batteries that are full-powered and 100 per cent new when you get them.

The new Philco Radio Batteries, with their remarkable "Philco Process Plates"—a revolutionary development in battery engineering—are CHARGED DRY at the factory. *Their life doesn't start until you pour in Philco electrolyte.*

This means that you can now get absolutely *fresh, charged* radio batteries—not partly worn out batteries that have lost charge and wasted away in the dealer's stock.

Philco Radio "A" Batteries have all the time-tested features of the famous Philadelphia Diamond-Grid Batteries—the standard for automobiles, mine locomotives and other heavy-duty purposes.

They give a uniform flow of voltage that assures absolute freedom from "cracking", "frying" noises and eliminates need for constant adjustments. Because of their Philco Retainers, they hold their charge longer than any ordinary battery, they are conservatively rated and will deliver all the electricity the name plates say they will deliver, and they are *guaranteed for two years.*

The Philco Radio "B" Battery, with its 24-volt capacity, takes the place of 15 dry cells and occupies far less space. Its 12 cells are neatly and compactly sealed in an attractive one-piece hard rubber case—a fit companion for the finest radio outfit.

Ask your radio dealer to show you these remarkable Philco Batteries, or go to any Philadelphia Diamond-Grid Battery Service Station.

Philadelphia Storage Battery Company, Philadelphia

RADIO DEALERS—Philco Dry-Charged "A" and "B" Batteries let you into the battery business on a package-goods basis, because they are shipped to you *charged but absolutely dry.* To make ready for use, just add conveniently bottled Philco electrolyte. No charging equipment. No acid sloppage. No batteries going bad in stock. Your customers are *sure* to get fresh, full-powered batteries. Wire or write for details.

PHILCO
SLOTTED RETAINER
BATTERIES
with the famous shock-resisting diamond-grid plates

Mail this coupon today
Sirs—I want to know more about the new Philco Radio Batteries.
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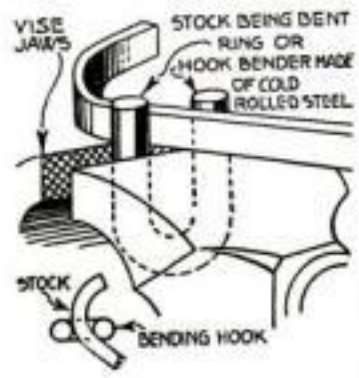
BETTER SHOP METHODS

Simple Ring Bending Fixture for Forge Shop Vise

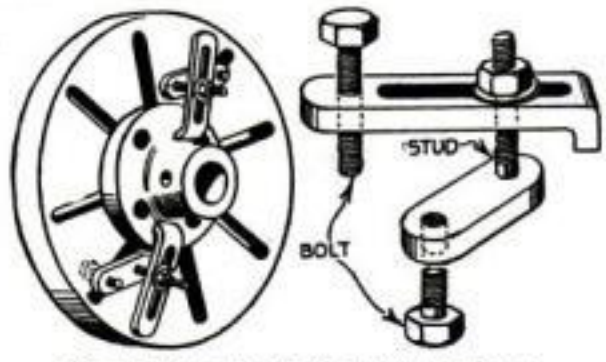
WHEN it is necessary to bend rings or hooks from flat or round stock, the bending fixture shown may be used to advantage. It consists only of a U-shaped section of heavy bar stock. This tool is clamped in the vise and the stock to be shaped is placed between the ends of the tool and bent to the desired shape. Several of these fixtures and a heavy vise will afford means for bending almost any stock that is apt to be handled in ordinary work.—L. A.



For making bends

Handy Faceplate Straps

IT IS sometimes difficult to fasten work to a lathe faceplate with the ordinary faceplate straps. To overcome this, I have

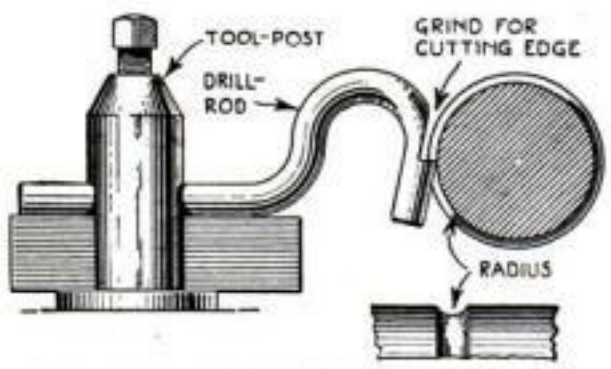


For holding work of awkward shape

made up several clamps as shown. They have proved a great help in holding work of an awkward shape, and have the additional advantage of requiring no blocking.—C. W.

An Easily Made Radius Tool

IT TAKES no little time to grind a radius tool, and without a radius gage it is hard to form the radius exactly correct in size. The accompanying illustration, however, shows one satisfactory way to make a gooseneck radius tool. The method is



Made from drill rod bent, ground, and hardened

so easy that a mechanic can make the tool in a very short time.

Take small pieces of drill rod of a size to form the radius required and bend a hook in one end. Grind one half of the hook in front as a cutting edge. After hardening, the tool is ready for use.

I now have almost all sizes of radius tools of this type and find that they are excellent and do not cause any chattering or roughness of cut.—C. E. KLINT.

THE BLADE ACHIEVEMENT
THAT ANTIQUATES OLD WAYS

Now Comes the World's Fastest Shave

78 Seconds from Lather to Towel!

—We offer it to you

WE worked for years to make the following facts true. Now, if you'll lend us a few seconds reading them, we'll pay you back with interest compounded tomorrow.

They change the whole shaving situation. Old methods are supplanted.

A new shaving era

We processed a barber's edge—the keenest cutting edge known—on a safety razor blade! That's the story in few words.

Now we offer you the world's fastest shave—a velvet shave in 78 seconds from lather to towel.

We talk in terms of time, because the only way to get a quick shave is with a super-keen blade.

Old-time ways won't do it. Put your watch before you and prove it to yourself.

"Strops its own blades"—Shaves, cleans, strops without removing the blade

Once over the face—that's all

With this new edge, you run over your face one time—*only*. A second is not needed.

And that's where you cut shaving time one-half. And spare your face, for dull-edged blades injure the skin.

Three men in four, past 35, skin specialists tell us, look ten years older than they are, because of improper methods of shaving.

No scraping No after-shave smart. No shaving lotions needed, this new way.

Sharpens itself

We recommend your using our famous strop for the same reason a barber strops his razor.

It keeps up the keenness. It works as a part of each razor—there if you care to use it, or, if you choose, you can just insert new blades as you feel the need. Self-stropping is a patented Valet Auto Strop feature.

It helps to give you the world's fastest shave every day.

Prove it by the clock

Pick up a Valet Auto Strop Razor at your dealer's. Then give it a whirl tomorrow. Shave with your watch before you.

Note the time—78 seconds for a velvet shave. That's our proposition. To you, it will prove a revelation.

$1 or $5

Valet Auto Strop comes in two styles. $1 and $5.

The four dollar difference is in the superlative finish of the latter. The 78-second shave, you'll find in either one you choose. Gold plated and sterling silver fitted sets—ideal for gifts—are priced up to $25.

3 Things in a shave you're never had before

First—a super-velvet shave going over the face *one time*. No scraping.

Second—a quick shave. 78 seconds from lather to towel. Only a super-keen blade can do it.

Third—a 78-second velvet shave *every day*. The strop keeps up the edge of the blade.

Mail This *If your dealer cannot supply you*

Autostrop Safety Razor Co.
654 First Avenue, New York City

Enclosed is one dollar ($1.00), for which send me one of the Model C Valet AutoStrop Razor sets complete.

Name .....

Street Address .....

City and State .....

Valet Auto-Strop Razor

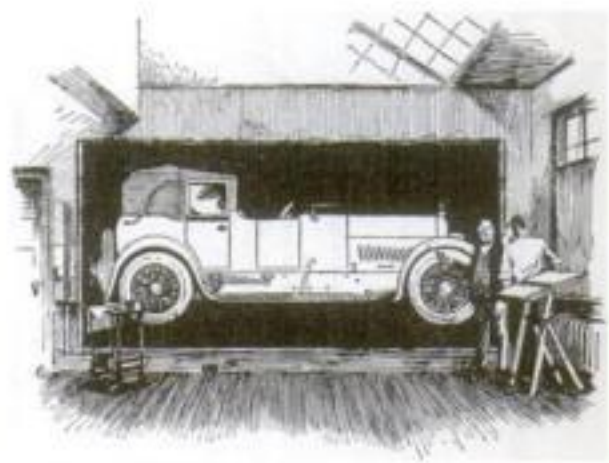
REGISTERED U.S. PATENT OFFICE

BETTER SHOP METHODS

Blackboard Used in Shop for Full Size Drawings

ON ENTERING the drafting room of a most successful designer of motor cars recently, I was struck by a large blackboard that nearly covered one side of the room. Upon it had been drawn a new design sketch. Touches of colored chalk made it appear almost like a real car when viewed across the room, and there was no question that the drawing gave a most accurate idea of what the finished product would look like.

It was the practice to have the detail draftsmen measure up the general dimen-



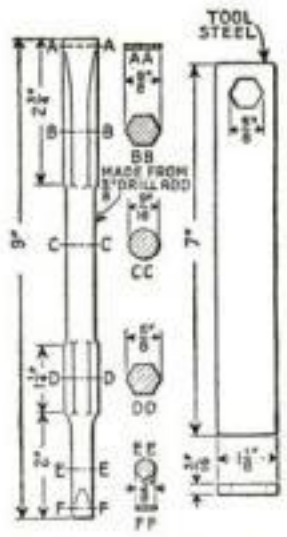
An auto designer's preliminary layout

sions from the board and work up the details. Photographs of the design sketch were also made and used both by the manufacturing and sales departments. To this system of working out his designs full size the designer credited much of his success.

The same idea should prove valuable to furniture and other designers, and even in the mechanical drafting room, where full size sketches could be made quickly for figuring out clearances of moving parts and for similar purposes that would not be served so well by a small drawing.—J. R.

This Screwdriver Is Useful for Heavy, Awkward Work

A SCREWDRIVER that is a decided improvement over the old square rod and monkey-wrench type is made as shown in the accompanying drawing. It can be used in tight corners and will serve readily as a ratchet by slipping the wrench up on the round part in the middle to release it and dropping it down on the hexagon for the next turn. If there is sufficient room, the wrench handle can be swung all around without dropping off as a monkey-wrench is apt to do.



Details of blade and wrench

For the mechanic who has to screw and unscrew tight, long machine screws, as in machine work or die making, this screwdriver is a real labor saver, and it has the advantage of not taking up much room in a toolkit. The business ends of the screwdriver and the wrench should be hardened and drawn to a purple or a color just this side of a blue.—H. L.

HOMCHARGE *your Radio Battery for a nickel!*

Enjoyable Radio Concerts and maximum receiving range are obtained only when your battery is fully charged.

Don't be bothered with the inconvenience and expense of taking your battery to a service station every few days for recharging.

Type "R" (Portable)
Radio Homcharger De Luxe

RADIO HOMCHARGER DE LUXE

has been designed especially for this purpose. It charges your "A" or "B" battery over night without removing it from your living room. The Homcharger is silent and clean in operation—no muss—no trouble—no dirt—requires no watching.

Simplicity itself. Attach to any lamp socket and connect to battery. Fully automatic in operation—cannot overcharge or injure your battery.

Constructed of the best materials—moulded Bakelite Base—Jewell Ammeter—Oversize Silicon Steel Transformer. No castings to break—only the finest stampings used thruout.

SAFE—all parts entirely enclosed—no danger from fire—approved by Fire Insurance Underwriters everywhere. Unconditionally guaranteed—lasts a lifetime.

Type "W" Homcharger for Wall Mounting
Over 50,000 in Use

An Ornament For Your Living Room

Beauty has been combined with utility in the NEW RADIO HOMCHARGER DE LUXE. The body is beautifully finished in rich Antique Mahogany—the base and fittings in a handsome dull gold. Equipped with rubber feet, it cannot mar polished surfaces. It harmonizes with the finest living room.

Over 50,000 HOMCHARGERS IN USE

50,000 users have heartily endorsed the HOMCHARGER. Beware of imitations when buying as *there is only one* HOMCHARGER. *Insist* on the genuine which bears our registered trade name, HOMCHARGER.

Furnished complete with attachment cord and plug, charging cable and battery clips. No extras to buy. Price at all good radio, accessory and electrical dealers, $18.50, or shipped prepaid upon receipt of purchase price, if your dealer does not carry it.

Booklet illustrating the NEW RADIO HOMCHARGER DE LUXE in actual colors is FREE for the asking. Send for your copy today.

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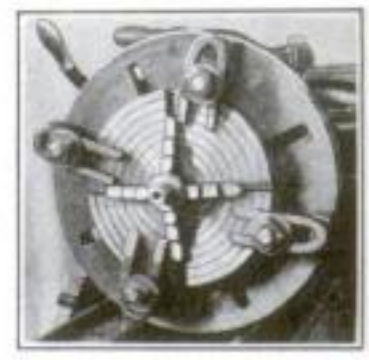
BETTER SHOP METHODS

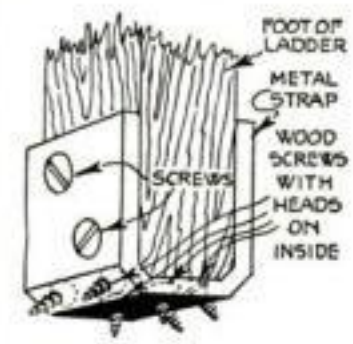
Using a Small Chuck on a Large Lathe Faceplate



I HAD to machine a large number of pieces that required a chuck to hold them. To hurry the work it was desirable to use a large lathe, but I had no chuck that would fit the lathe. I took a chuck from one of the smaller lathes and centered and clamped it on the faceplate of the large lathe. The illustration shows how this was accomplished.—HARVEY MEAD.

A Ladder that Won't Slip

MANY a man has been injured by the slipping of a ladder on a smooth or oily floor. Where special shoes are not on hand for the ladders and where it is not important to protect the floors from being marred, it is a simple matter to use the method illustrated for preventing ladder accidents.

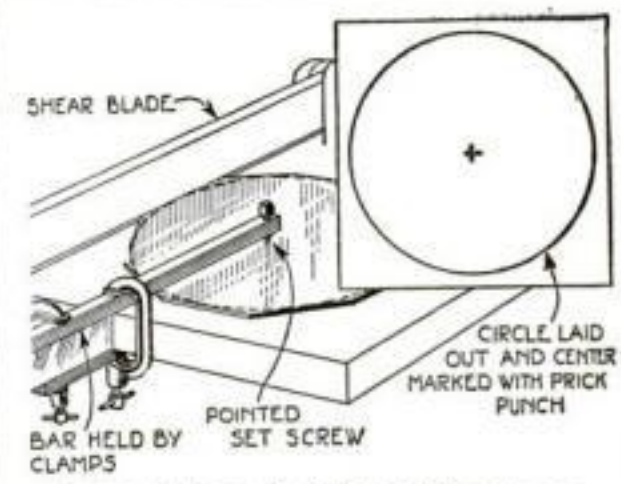


Ladder shoe studded with screws

Simply drill some holes through a piece of strap iron of suitable thickness and length, and fasten with screws to the base of the ladder as shown. The number and size of screws will depend upon the size of the ladder and the kind of floor on which it is to be placed. On all but metal floors this device proves an effective and dependable safeguard.—N. G. NEAR.

Cutting Sheet Metal Disks with the Bench Shears

CIRCULAR or semicircular plates of sheet metal may be cut with a straight blade shears, if the method illustrated is used. A pointed set screw is threaded into the end of a bar and used to center the



As metal is revolved, blade trims to approximate circle

plate to be cut at a distance from the blade of the shears equal to the radius of the required circle.

The bar is clamped firmly to the bench in any convenient manner and the metal is turned while a number of roughing cuts are made. These are followed by a series of finishing short cuts, which will bring the edge to a fairly true circle.—A. L.

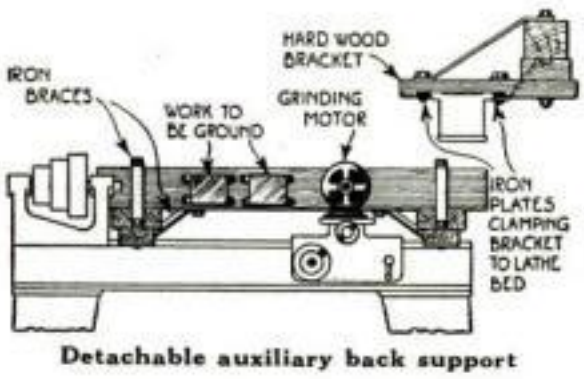
BETTER SHOP METHODS

Wooden Lathe Fixture Supports Work for Grinding and Milling

WHEN a small lathe is equipped with grinding and milling attachments, the work must be held either between centers or, in the case of the milling attachment, sometimes in the milling spindle chuck. It is often convenient to grind or mill flat surfaces or work that cannot very well be attached to the faceplate, or held in a chuck or between centers.

To overcome this difficulty, as well as to increase the usefulness of the lathe, an auxiliary back support for the work may be made of heavy lumber and quickly attached or detached from the lathe bed. The work is screwed, bolted, or clamped directly to the back piece, as shown in the illustration, where two small cast-iron bases are screwed on so that their top surfaces can be finished ground by means of a cup wheel on the shaft of a small motor bolted to the cross slide of the lathe.

For milling, the back timber, in most cases, would have to be brought nearer the lathe bed, but the brackets can be left long



Detachable auxiliary back support

and several holes drilled so that adjustments can be made to suit the work in hand.

A timber support of this kind must be heavy and well braced, and even then is suitable only for light milling or grinding. The two brackets are made of oak planks, but they might be constructed of iron or steel bar, angle stock, or cast iron. The bottom is recessed to fit over the lathe bed. The method of clamping depends entirely upon the type of lathe. Here the bed was of the double V type and the clamps were made of two short lengths of bar iron $\frac{3}{8}$ by $1\frac{1}{2}$ in., with one edge filed to a 60-degree angle.

One of the pieces was bolted permanently in the lower notch of the hard wood bracket; the other acted as the tightening clamp and was loosened for removing the bracket. Strap iron diagonal braces are essential to prevent the springing of the work support and are best attached to the same bolts that hold the timber to the brackets.

In general, it is best to use a back timber the full length of the lathe bed so that long work may be handled, but extra bolt holes should be provided and the brackets set closer together to obtain extra stiffness for short pieces of work.—H. H. P.

Coarse Sand Is Best for Making Concrete

IN MIXING concrete for constructions that require great strength and durability, select sand that contains a large proportion of coarse particles. The greater part of the sand should be coarse enough not to pass a sieve containing 50 linear divisions to the inch.—S. M. H.

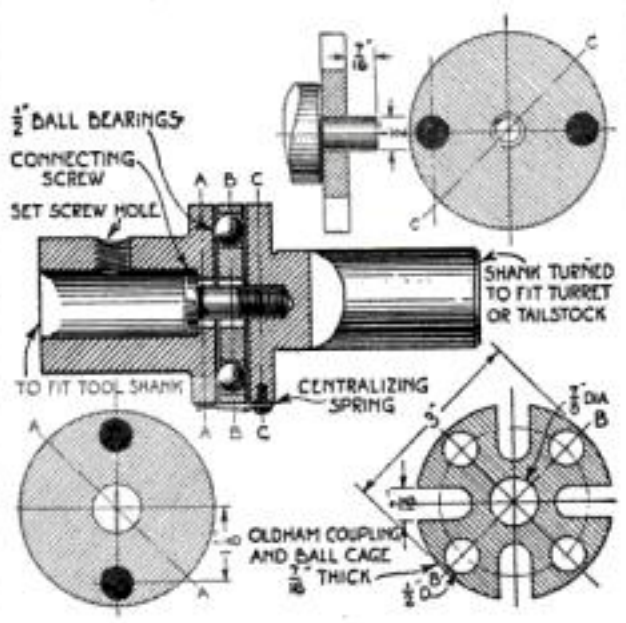
BETTER SHOP METHODS

Full Floating Reamer Holder Insures Accurate Reaming

By Joe V. Romig

FOR very accurate reaming work, floating reamer holders are used because they allow the reamer to adjust itself to any slight misalinement between the bore and the true axis of the lathe spindle. Reamers held rigidly will invariably trail a mark through the bore and also they are apt to cut large and untrue. While there are many types of floating reamer holders, one of the best and most sensitive is the full floating, ball bearing type, as shown in the accompanying drawing.

As the parts are made mainly of cold rolled steel shafting, any mechanic can turn up and make this full floating holder. The design incorporates a ball bearing thrust feature, in conjunction with the familiar Oldham's coupling. This coupling allows a slight movement in any direction sufficient for the requirements, and the ball bearing



Ball bearings make this holder sensitive

feature permits the fore part or reamer holding part to roll and adjust itself to the center of the bore.

The construction of the holder is simple. The rear part, being turned to fit the hole in the turret, is tapped for the connecting screw and is fitted with a spring at its bottom side to support the weight of the fore part. This spring makes for the centralizing of the fixture, as otherwise the weight would pull the whole below the center line.

The coupling part is turned up out of soft steel, and is drilled and slotted to the sizes given in the sketch. The 7/8-in. holes allow the disk to play freely over the connecting screw.

The fore part is turned up and bored to fit the reamer shank, or bored to a size large enough to use bushings for the smaller reamer shanks.

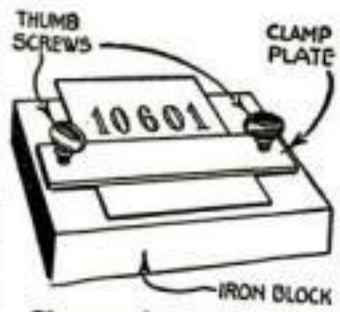
The through hole is of 7/8-inch size. The connecting screwhead overlaps the edge of the hole and holds the whole assembly together, the under surface of the head sliding in the bottom of the bore. Both surfaces of the two end parts, which form the ball race flats, must be case hardened. The balls used are ½ inch diameter for the size of holder shown, and this holder will take care of any size reamer up to 2½ inch diameter.

Pins are inserted in the two end parts and engage opposite slots in the center disk. Since the accuracy of the alinement of the whole tool depends upon these pins and their slots, care should be taken in the machining of the holes and slots.

BETTER SHOP METHODS

Clamp and Gage for Numbering with Steel Stamps

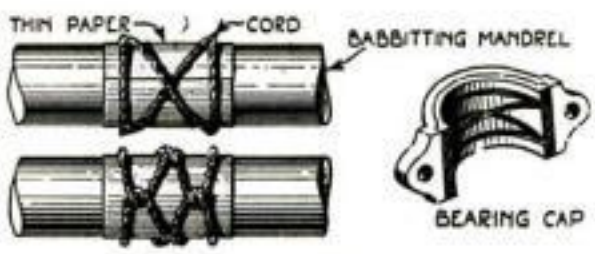
WHEN serial numbers or letters have to be stamped on name plates or other work, it is often best to use a holder and gage such as is illustrated. The base, preferably an iron block, has hole at each end tapped for ¼-in. thumbscrews. The clamp and gage plate is a short length of ⅛ by 1 in. stock drilled at each end to correspond with the thumbscrew holes. This arrangement will be appreciated by any one who has tried to stamp a straight row of figures or letters guided by the eye alone.—J. P.



Clamp plate serves as guide

Rebabbitting Bearings Easily

ONE of the quickest and easiest expedients for rebabbitting connecting-rod or crankshaft bearings in a gas engine is wrapping the shaft with a piece of well oiled paper, tying it with a piece of twine



Cord forms core for oil grooves

arranged in the same shape as the desired oil grooves, and pouring the metal. The thin paper filling affords a clearance and makes unnecessary excessive scraping; and the channels formed by the twine take the place of grooves cut by hand.—A. G.

Repairs Made by Electroplating

THE loss of even a small fraction of an ounce of metal from some part by wear often makes it necessary to make or purchase a complete new part, meanwhile tying up the whole machine tool. In many cases, however, worn parts can be restored to their original dimensions by depositing on them electrically a film of metal—nickel is good on account of its hardness—of the requisite thickness.

The part is cleaned thoroughly and dipped into melted wax. When the film of wax has cooled, it is scraped away from the surfaces that require treatment and the part is immersed in the plating bath. As the metal is deposited very slowly, it is easy to work to very close limits; yet, if sufficient time is allowed, the deposit may attain a thickness of 1/10 in. or more.

If the operation is properly carried out, the nickel adheres to its foundation very tenaciously and is quite continuous and of even thickness throughout. In this way expensive and heavy items, such as crankshafts, cylinders, and pistons, can be made serviceable again at a cost far smaller than that of a new part. At the other end of the scale, very slight wear in delicate machinery, in which close adjustment is essential, may be put right by a metal film of the exact thickness required.—F. H. SWEET.

BETTER SHOP METHODS

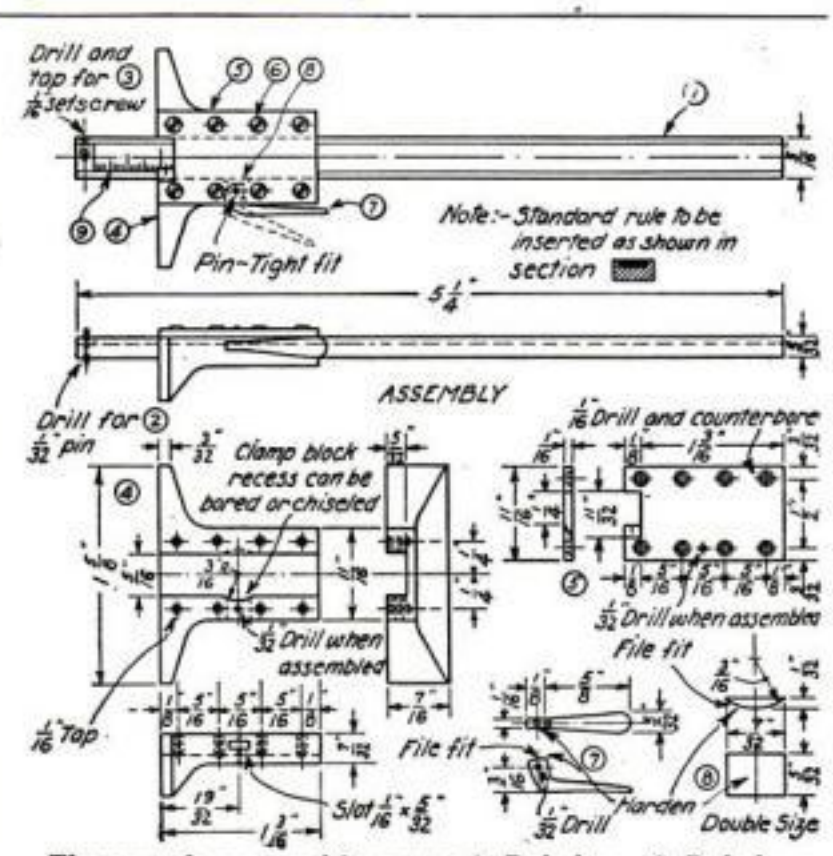
Four Useful Tools for the Machinist

(Continued from page 76)

viding heads, and drill chucks. In use the gage is forced into the taper and the two parts being a snug fit conform with a sufficient degree of accuracy to the taper being measured. To complete the measurement the gage is placed in a spacer, as shown, so that measurements can be made with a micrometer. Two of these spacers can be made, one as shown and another shorter one to give the taper for one inch.

The scratch gage is for laying out work quickly without the use of a height or surface gage, when the accuracy required is not so great as to make the use of those tools imperative. The sliding piece and its top plate are made of mild tool steel. A standard 4 or 6 in. narrow scale with either 1/64-in. or 1/32-in. gradations is set in the bar flush with the top.

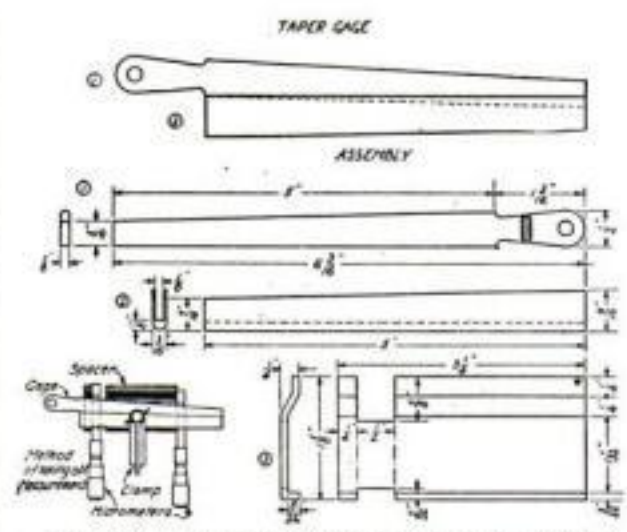
By actual trial the cam lever was found to be more satisfactory than a setscrew, for tightening slider in position on bar. It is let into the side of the slider and bears on a hardened, crescent-shaped shoe. The scratch point is a piece of drill rod fastened with a screw in the side of the bar and located so that when the line on the slider plate is set at zero, the point is even with the working surface of the slider. The point should be sharpened with an oil stone.



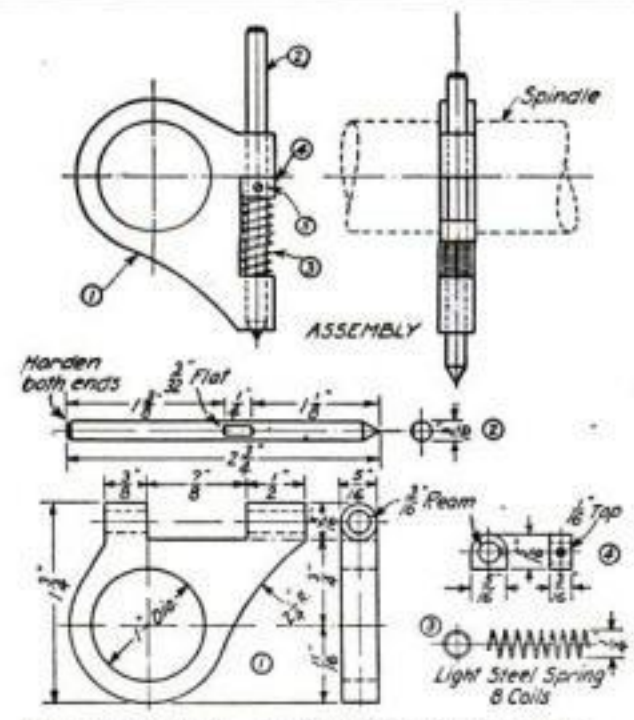
The scratch gage and its parts: 1. Rule bar. 2. Rule bar pin. 3. Rule bar pin setscrew.] 4. Slider. 5. Slider plate. 6. Slider plate screws. 7. Clamp lever and pin. 8. Clamp lever-block. 9. Standard rule

The cam lever is hardened and a slight pressure locks it. The bar should be a good sliding fit in the slider body.

The eccentric boring chuck and the taper gage were designed and made by Mr. Roberts; the milling machine center punch and the scratch gage by Mr. Frank Killam.



Illustrated at left is the taper gage, which has only 3 parts. 1. Inner half. 2. Outer half. 3. Spacer. It can be made in other sizes. The method of using it is shown in the small detail. At the right is shown the milling machine punch. 1. Holder. 2. Punch. 3. Spring. 4. Spring retainer. 5. Spring retainer screw

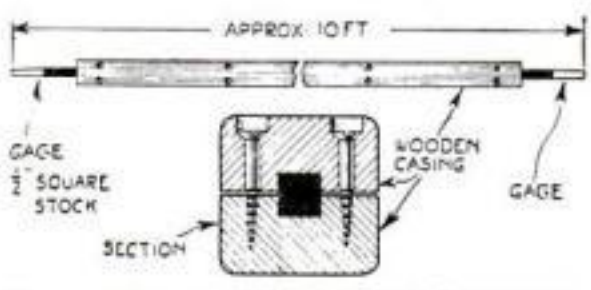


Wooden Casing Stiffens Long Gage

IN THE construction of some large castings it was necessary to use a gage to test a circular bore of approximately 10 ft. to determine if it deviated from a true circle.

A gage 10 ft. long would have been hard to handle and quite expensive if made entirely of metal. Instead, ½-in. square bar stock was used, stiffened with a split wooden casing about 2 in. in cross section, as shown in the accompanying diagram.

This made a very straight and stiff gage, light enough to be lifted about by hand and accurate to the thousandth part of an inch. It was also inexpensive to make.—R. G.



Inexpensive method of making long gages

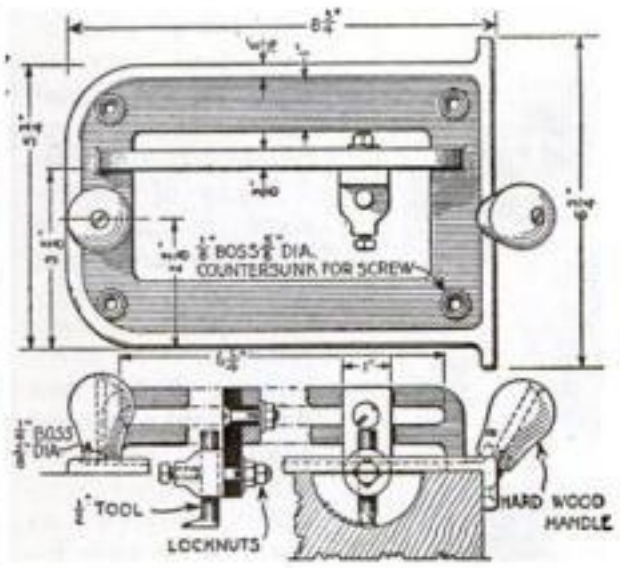
BETTER SHOP METHODS

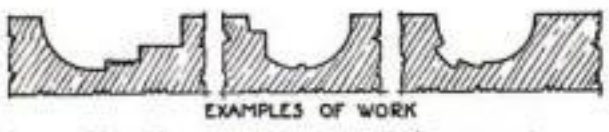
Core-Box Plane and Router for the Pattern Shop

By Henry S. Laraby

THIS core-box plane is an improvement on the old-fashioned right-angle type and has the additional advantage that it can be used as a router.

The frame should be made of cast iron or aluminum. With three knives of different lengths, any size of core-box from 1 in. to 5¼ in. can be worked out. Before the plane is used, the work is usually roughed out to within 1/16 in. of the finished size by means of a circular saw or gouges. A cutter





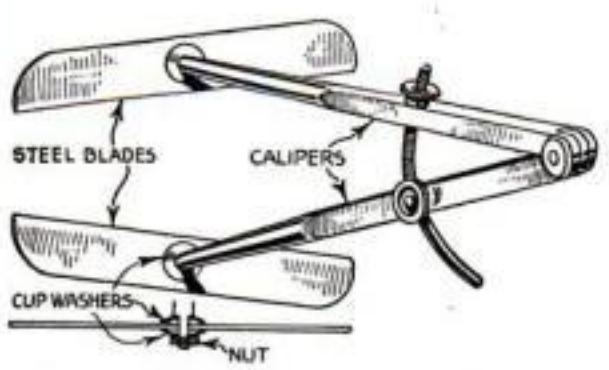
Handles many varieties of recessed planing

of the proper length is then fastened in the plane and it is run over the work, the knife swinging to the set radius. The frame provides a very good bearing and guide.

All kinds of forms are possible if the necessary knives are used. The plane can be used on irregularly shaped work by screwing strips of wood to the side of the work to guide the plane in following the desired shape. To my mind this is one of the handiest tools in the patternmaker's kit.

Axles Machined with Aid of Tapered Calipers

IN MACHINING the end tapers of automobile rear axle shafts, I have found it difficult to obtain a taper measuring instrument that could be used close up to the tailstock or chuck, while the work was still



Can be adjusted for taper and thickness

in the lathe. So I devised this taper measuring caliper, which fully meets the requirements. The blades are held between two cup washers and tightened with a nut; they can, therefore, be adjusted to any desired taper.—D. E. CRABB.

The Home Workshop

(Continued from page 75)

Craft Work Designs Made with Shadows

By E. Bade

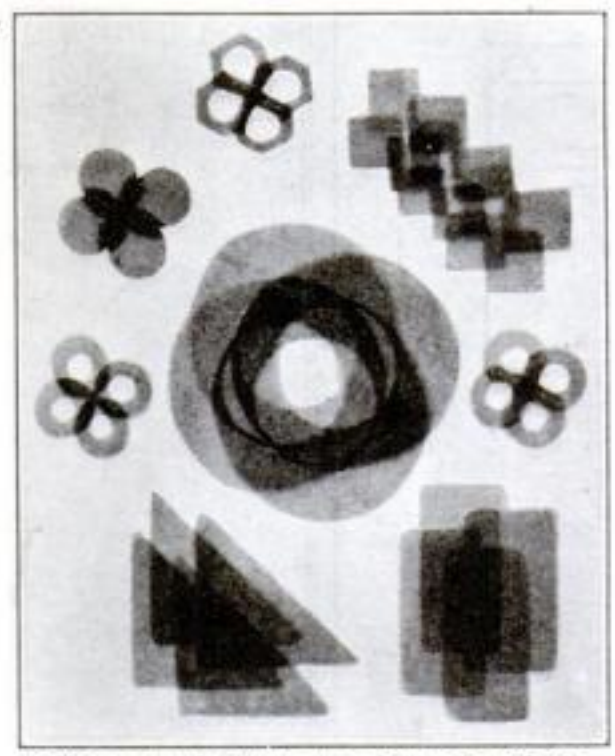
EVERY home worker who has ever attempted to do artistic handiwork and is interested in the decorative crafts, finds continual difficulty in obtaining good designs for use as ornaments. This is equally true in regard to stencil ornaments for woodwork, designs for tooled leather book covers, patterns for textiles, or ornamental units and borders for handmade jewelry, hammered brass and copper work, wood carving and embroidery.

To originate really good designs requires much time, energy, and innumerable experiments on the part of even a trained designer. On the other hand, to take ready-made designs from books and commercial stencils is never satisfactory to the true craftsman, because many of the designs are hackneyed, commonplace, and inappropriate.

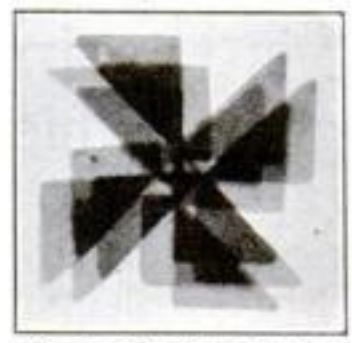
This problem may be solved by a uniquely simple method that enables the craftsman to originate innumerable designs to serve the purposes of whatever work he has in hand.

The apparatus necessary makes use of shadows cast by an arrangement of mirrors in conjunction with an electric or other light. Four mirrors of equal size are provided with brackets made from strips of brass or heavy wire, as illustrated, and arranged about an inverted lampshade, so that they are spaced at equal distances and angles from the light. The brackets should be bent so as to throw the light downward on one spot immediately below the lamp.

The apparatus is completed by a pane of glass blocked up so that it rests an inch or two above the table.



The central figure was formed with 3 washers of different sizes; a rectangle, triangle, hexagon nut, and similar simple objects provided the other patterns

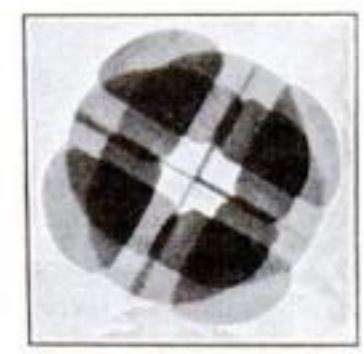


Made with 4 triangular stone blocks placed in the form of an open Maltese cross

The shadow designer with its 4 mirrors arranged symmetrically about an inverted lampshade so that the light is thrown downward upon a raised piece of glass that carries the object provided for casting the quadruplicate shadows

If any sort of a regular or symmetrical object, even so simple a one as a cube, a washer, or a coin, is placed upon the glass and the lamp is turned on, a shadow design will be thrown upon the sheet of paper placed below the glass. This is because the light reflected by each of the four mirrors casts an individual shadow, each overlapping the others.

Many of the designs obtained in this way are most wonderful, not only in shape but in tone relation. The overlapping lights and darks make several shadows of gray that are harmoniously related to each other and invariably in proportions that are delicately balanced and pleasing to the eye. All the designer needs to do is to copy the design, either freehand, by tracing, or by exposing a sheet of photographic printing paper under the glass plate. The design can be modified to suit the place in which it is to be used. If in color, substitute colors for the grays in the toned areas in the shadow design.



Four pointed blocks, each with one side rounded, arranged in open formation

Other arrangements of mirrors can be used, or even the direct light of a 3- or 4-bulb fixture, used without mirrors. Raising or lowering the pane of glass in relation to the table will also be found to vary a design materially without any other alterations. Objects for casting shadows may be of the simplest variety — buttons, paper clips, regularly placed and spaced matches, wheels, gears, toy blocks, and other odds and ends.

With this interesting, easy, and practical method of obtaining good working designs, no home worker need ever be at a loss for decorative motives at once artistic and original.

THE HOME WORKSHOP

WIN A PRIZE FOR YOUR BEST IDEA

WHENEVER you make something that is particularly novel and useful, or discover some new and valuable way to use your tools to better advantage, think of the Home Workshop Department. It exists primarily to publish just such ideas and not only pays well for them, but awards each month a first prize of $15 and a second prize of $10 for the best suggestions sent in by readers and contributors.

Your letter or manuscript need not be long; in fact, the shorter it is, the better, provided it explains the idea clearly and contains sufficient data in the way of description, sketches or photographs for purposes of preparing the illustrations.

The prize-winners for October are:

FIRST PRIZE, $15: **Herbert A. Mincher,** Youngstown, Ohio, "Unique Floor Lamp with Caned Pedestal Can Be Made with Few Tools" (see page 75).

SECOND PRIZE, $10: **Gladstone Califf,** Richland, Ia., "Tool Grinder Provides Power for Sandpapering Machine" (see page 93).

Make a Radio Set

NOW is the time to make a radio receiving set, to prepare for fall broadcasting.

The most popular set is the vacuum tube detector set using the regenerative circuit, with two stages of audio frequency amplification. Full details for making this set can be obtained by sending 25 cents to the Blueprint Editor for Home Workshop Blueprint No. 6. It should be noted that the set can be made up first as a single tube receiver and the amplifying steps omitted or added later, if preferred.

Many letters have been received from our readers, telling of success in making the blueprint set.

Coupon for Ordering Blueprint

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have checked below, for which I inclose....cents in stamps or coin:

No.	Title	Price	
1.	Sewing-Table	25c	☐
2.	Smoking Cabinet	25c	☐
3.	Book Trough End Table	25c	☐
4.	30-ft. Monoplane Glider	50c	☐
5.	Kitchen Cabinet	25c	☐
6.	V.T. Radio Receiving Set	25c	☐
8.	Shaving Cabinet	25c	☐
9.	Arbor with Gate and Seats	25c	☐
10.	Porch Swing	25c	☐
11.	Bench and Tilt-Top Table	25c	☐
12.	Electric Washing Machine	25c	☐

Name.....
(Please print)
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City and State.....

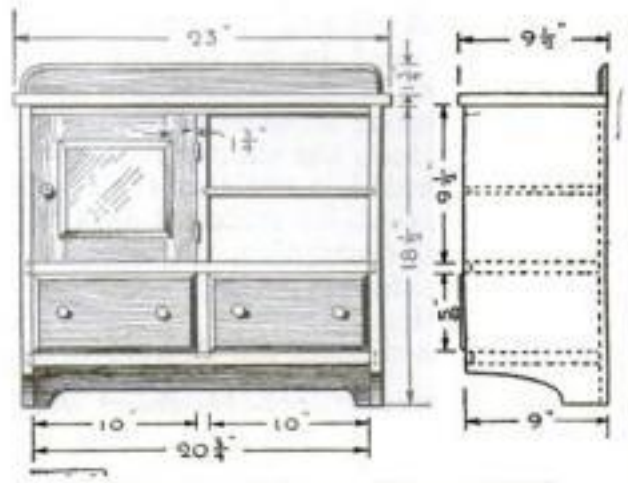
THE HOME WORKSHOP

Constructing an Enameled Wall Cabinet for the Small Bathroom

By Clifford A. Butterworth

FOR the small bathroom, where there is no room for built-in drawers or a cupboard, this wall cabinet will prove convenient. It has a closed compartment for medicines, two shelves, and two good sized drawers in which towels may be kept.

Made mainly of ¾ or ⅞ in. whitewood, it is glued together, with a few nails for

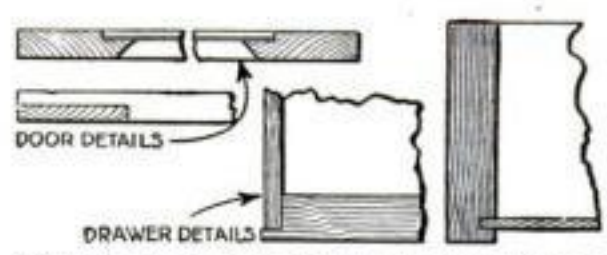


Front and end views with suggested dimensions

reinforcement where necessary. The finish is white enamel.

The back is cut 21 by 20¾ in., and projects 1¾ in. above the top. The top projects ½ in. at the front and sides. A ½-in. strip is fitted over the door and shelf compartment. The door frame is made of ½-in. stock 2 in. wide. The corner joints and section through the frame is shown in the door details. Either a mirror or a thin wooden panel can be used.

The drawer fronts are of ¾-in. stock, the sides of ½ in. The sides are fastened to the front with glue and nails, the joint being made as in the left-hand drawer detail. The bottom is ¼-in. stock and fits into grooves cut in the sides as shown. The drawer



How the door and drawers are constructed

fronts are beveled off 3/16 in., and the drawers are fitted so that they project that amount when closed, as indicated in the side view. The door and drawers are fitted with knobs. The open shelf is made of ½-in. stock and is either dadoed into the end and partition or supported by small cleats. A shelf also may be fitted in the medicine compartment, if desired.

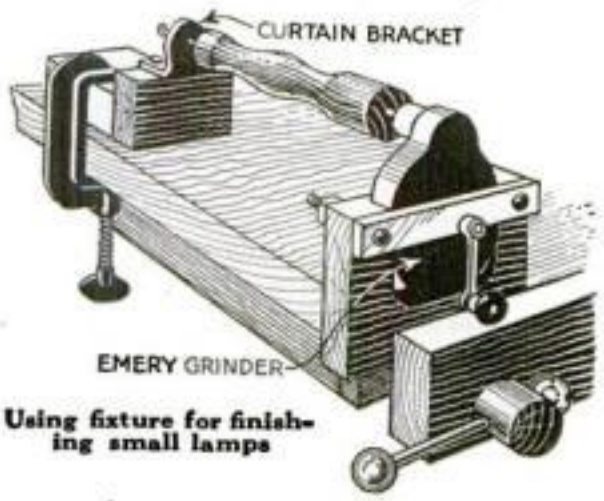
When the cabinet is completed, the nails are set and it is given a coat of flat white paint. The holes are then puttied, and it is given two coats of of enamel.

A GARAGE that specializes in polishing cars makes its own body polish. This produces a fine luster that does not collect dust or show rain streaks. Although not a cheap polish, it is less costly than the usual polishes sold in cans or bottles. It consists of ½ gal. turpentine, ½ pt. paraffin oil, 2 oz. oil of citronella, and 1 oz. cedar oil. These are thoroughly mixed, applied with a soft cloth, and rubbed lightly and briskly until dry—T. S. F.

THE HOME WORKSHOP

Tool Grinder Provides Power for Sandpapering Machine

FOR finishing and polishing round pieces of wood, such as boudoir lamp bases and shafts, a sandpapering machine can quickly be rigged up with the aid of an ordinary tool grinder. The grinder is clamped in a wooden holder by means of a strip of wood and two bolts, as shown, and this holder is held in the vise. The spindle, from which the emery wheel is removed, forms the live center. A dead center is made with an L-shaped block of wood and

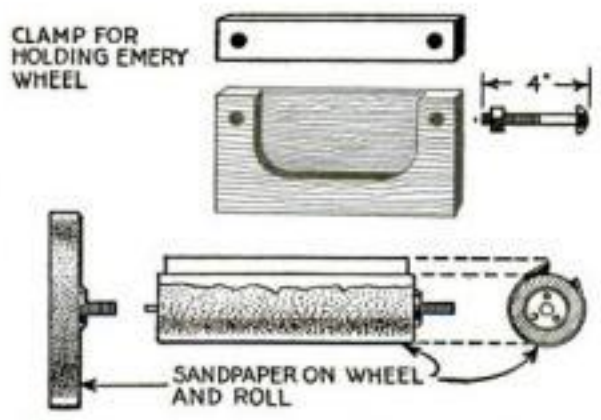


Using fixture for finishing small lamps

a windowshade bracket, the whole being clamped to the bench with a C-clamp.

Small turned pieces can be sandpapered, finished, and polished by using the device as a lathe. In addition, a circular disk about 6 in. in diameter can be covered with sandpaper and attached to the live center to serve as a disk sander. In the same way a drum can be used between centers.

This fixture was used in making several electric reading lamps from old table legs. When cut to the right size and the old varnish removed, each shaft was mounted in the machine and stained. Then a French polish was applied. This was done by making a pad of soft cloth, free from lint and dipping the inside center of the cloth in shellac. Another piece of cloth was placed over it and twisted, so that by twisting the outside piece a little harder from time to time, the shellac on the inner pad was squeezed out. The pad was dipped in linseed oil occasionally to prevent it from sticking. The machine was first speeded up and then the pad was applied until the wood would absorb no more



Details of emery wheel clamp and sanders

shellac. After one coat had thoroughly dried (in twelve hours or more), the operation was repeated until at least three coats had been applied.

The bases were cut on a scroll saw and then attached to the live center by means of a screw, and sandpapered. In this way they were made almost as true as if they had been turned in a lathe. The completed product looked like a lamp bought in the stores.—GLADSTONE CALIFF.

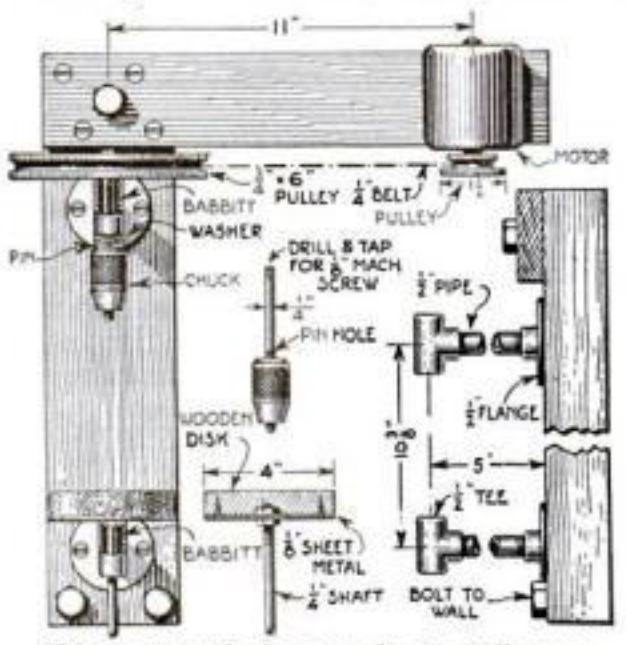
Building a Drill Press for the Home Workshop

By H. L. Johnson

TO MAKE a drill press that will pay for itself in the time it saves in the home workshop is not at all difficult. The materials needed are as follows:

1 ¼-in. drill chuck with a ¼-in. shaft 1⅝ in. long, drilled and tapped on end
2 ½-in. pipe tees
2 ½-in. floor flanges
2 4¼-in. lengths of ½-in. pipe, threaded both ends
1 12-in. piece of ¼-in. shafting threaded on one end, with two nuts to fit
1 disk of ⅛-in. brass or steel 4 in. in diameter
1 sewing machine motor or motor about that size
12 1½-in. wood screws
4 ½-in. wood screws
3 ft. of ¼-in. or 3/16-in. round belting
1 18-in. piece of 2 in. by 4 in. oak or pine
1 piece of 14 in. by 2¾ in. by ⅞ in. oak or pine
1 piece of 12 in. by 6 in. by ⅞ in. oak or pine
1 1 in. by ⅛ in. washer with a ¼-in. hole
Some Babbitt metal and two 1 in. by ⅛-in. washers with ⅛-in. holes

The frame is built by screwing together the 12- and 14-in. lengths of oak or pine at right angles to each other. The pipe tees are then babbitted by coating the ¼-in. shaft smoothly with white lead, centering it in the tees, closing the ends



Front view of the completed drill press and details of pipe bearings, table, and chuck

with cardboard washers on the shaft reinforced with putty, and pouring hot babbitt in through the third opening. After the babbitt has cooled, the shaft may be twisted out. The floor flanges, pipe and tees are next assembled as shown. It is easier to line them up properly if the shafting is first run through the tees.

From the remaining piece of wood cut or turn three disks 6 in., 4 in., and 1½ in. diameter. The 6-in. disk is grooved for a ¼-in. round belt, and a ⅛-in. hole is drilled through the center. The 1½-in. disk is turned down to 1 in. in diameter for two thirds of its width, and also grooved for the belt. If a lathe is not available, this disk can be made in two parts.

The 4-in. disk is bored with a ½-in. bit to the depth of ¼ in. Then drill a ¼-in. hole in the center of the 4-in. brass disk, and four other countersunk holes for ½-in. wood screws. Mount this disk on the threaded end of the ¼-in. shaft, which should first be run through lower tee. Then fasten the wooden disk to the brass disk.

The ¼-in. drill chuck, which can be purchased at a hardware store, should have a hole drilled through its shaft 1/16 in. above the chuck head when all the jaws are closed. The 1-in. washer is then slipped on the shaft and rests on a pin or

(Continued on page 95)

THE HOME WORKSHOP

Building a Drill Press

(Continued from page 94)

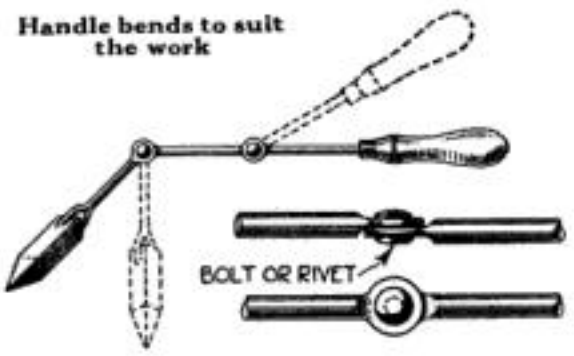
nail driven through the hole. This is done to take care of the upward thrust of the chuck in drilling. The chuck shaft is then passed through the upper tee and the large pulley with a washer countersunk on the top and bottom is fastened to the shaft with a ⅛-in. round-headed machine screw. A small hole is then drilled in the outer end of the slot in screw head and down through the top washer. In this hole a small finishing nail is driven to prevent the screw from turning.

In operation the work is brought up against the drill by raising the lower disk.

Soldering Copper with Flexible Handle for Awkward Places

BY INSERTING one or two joints in the ordinary soldering copper handle, it can be improved for use on parts that are awkward to reach.

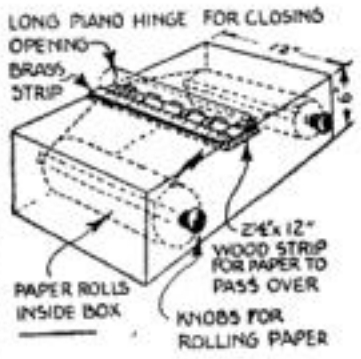
Cut the handle in two and flatten out the ends by either heating and hammering flat



or else sawing out roughly to shape and flattening cold. Make a third section from iron rod and flatten both its ends. Drill all the flats with ⅛-in. holes and rivet them together with steel rivets or join them with small stove bolts. See that the joints are very stiff so that they will stay set in any position.—L. B. ROBBINS.

A Continuous Record Box

A NEAT record-keeping device, useful for many purposes where daily and hourly records are to be checked, was made by fitting a rectangular box with two spindles, upon which a roll of paper was held. The paper was fed through a slot in the center and over a 2½ in. by 12 in. strip of wood to the opposite roller. The slot was 1 in. wide, the wood strip over which the paper was stretched forming a backing.



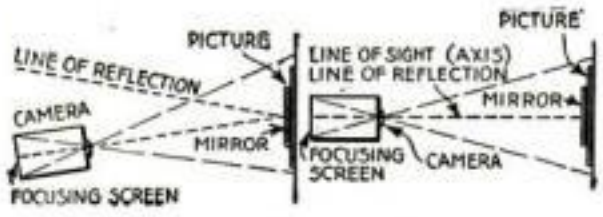
For preserving records in serial order

A thin brass strip was fitted and screwed on one side of the slot and a piano hinge on the other. Divisions marking hours and half hours when the records were to be entered were stamped on the brass piece to keep the spacing of the record uniform.

The device was used in a power plant to record amperage and was also a check against the automatic recorder to show the engineer that his assistant was watching loads and switchboard requirements.—T.H.

Mirror Aids in Setting the Camera for Copying

IN ORDER to avoid distortion when making a photographic copy of a picture or record, it is necessary that the line of sight or axis of the camera be perpendicular to the plane of the picture to be copied. A photographer who does much of this kind of work has a special stand upon which he can set up his camera and picture; but for those of us who seldom do copying work, such a stand is too expensive to buy and too troublesome to make. Here is an easy and accurate way out of the difficulty:



Reflected image of lens should appear in center of focusing screen

Tack the picture to be copied flat against a vertical wall or lay it on the floor or a table. Set the camera as nearly opposite the center of the picture as can be done by guess. Lay a small flat mirror face up on the middle of the picture; then focus the camera on the mirror.

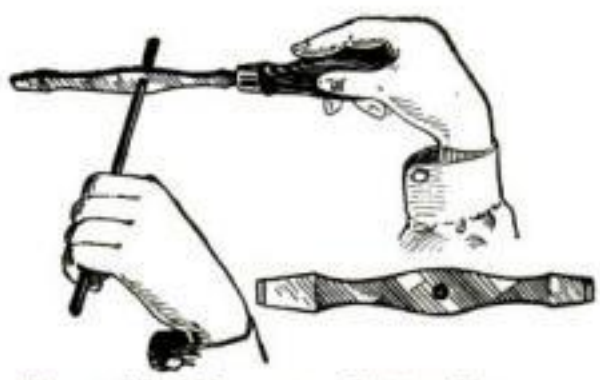
If the line of sight or axis of the camera is the least bit off of the perpendicular to the plane of the mirror—that is if it makes an angle of less than 90 degrees with the plane of the mirror—we can see that the line of reflection of the image of the lens makes the same angle with the mirror and that the two lines do not coincide, as shown in the diagram at the left. In order for the line of sight and the line of reflection to coincide as shown in the right-hand diagram and bring the reflected image to the center of the screen, they both must make right angles with—or be perpendicular to—the plane of the mirror. Therefore, if we move the camera a little at a time and finally bring the reflected image of the lens to the center of the focusing screen, we know that this condition has been fulfilled and that the camera is in the desired position.

After removing the mirror and focusing the camera on the picture, everything is set for successful copying.—F. W.

Powerful Double-End Screwdriver

TO ADAPT a screwdriver for exerting great force on tightly wedged screws, bore a hole in the center of the blade and insert a steel rod, which will serve as a lever.

The usefulness of the screwdriver may be increased still further by having a double-end blade. If the socket in the handle is large enough to hold the larger end of the driver, the smaller end may also be inserted.—W. J. T.

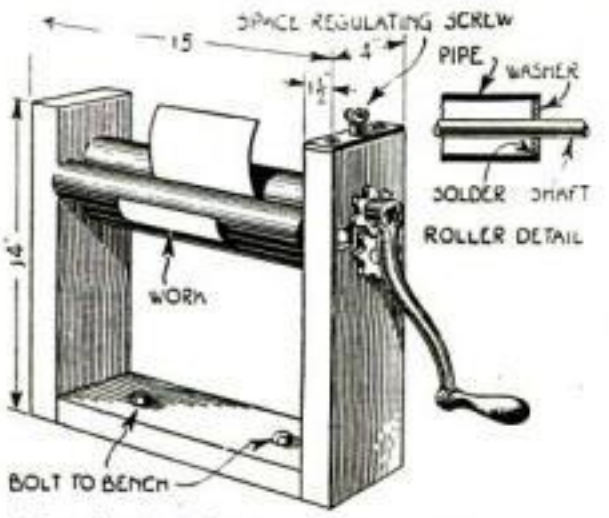


The rod provides great additional leverage

THE HOME WORKSHOP

Old Clothes-Wringer Converted into Bending Machine

WITH the gears, handles, and roller axles of an old clothes-wringer, three 1¼-in. galvanized pipes, and a few bolts, I made a sheet metal bending machine for



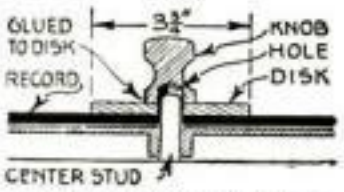
For shaping sheet metal into cylindrical forms without a hammer

my home workshop. With it I can round tin into cylindrical shapes without a hammer. The drawing shows clearly the details of the construction.—CARL BONAVITA.

Protecting Phonograph Records

IF YOUR phonograph and records are not provided with one of the patented devices to prevent the damage that is often caused by not stopping the machine promptly at the end of a record, you can make one yourself in a few minutes' time at little or no cost.

From an old record, a piece of sheet metal, or any reasonably hard smooth-grained material 1/16 to ⅛ in. thick, cut a true circle 3¾ in. in diameter and drill a hole in the center just large enough to slip easily over the turntable spindle. Round off the edge of the disk with emery cloth.



Disk stops handle from damaging record

The disk is placed on top of the record being played, so that if the needle leaves the end of the groove and starts on its destructive journey, the side of the needle strikes the smooth rounded edge of the disk before it reaches the paper label and the machine can run indefinitely without danger of injury to mechanism or record.

A small knob may be fastened to the center for greater convenience in lifting off the disk.—GLEN MCWILLIAMS.

What to Do when Your Last Hacksaw Breaks

WHILE cutting off the end of a projecting bolt, a service station mechanic buckled the blade of his hacksaw and snapped it off about 2 in. from one end. While he went for a hammer and chisel to finish the job, the foreman picked up the broken blade, held it in the flame of a blowtorch and, while it was still warm, drilled a hole through it with a hand drill. He then replaced it in the adjustable saw frame and had the saw ready for finishing the job by the time the mechanic returned.

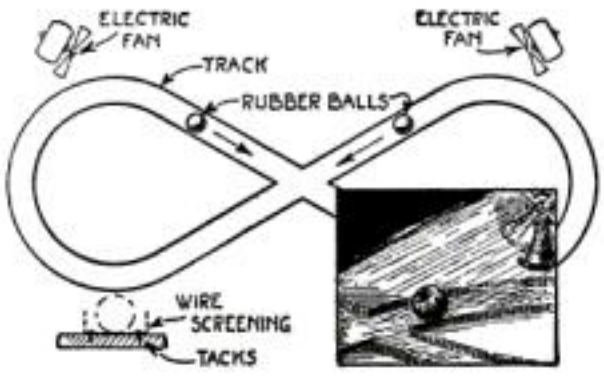
This is a stunt well worth remembering because it is usually the last hacksaw that breaks the quickest.—S. R. D.

THE HOME WORKSHOP

Perpetual Motion Rubber Balls Form Store Window Novelty

A WINDOW display feature that is guaranteed to attract a crowd consists of two concealed electric fans, two rubber balls and some wire window screening.

The screen wire is cut to form a figure eight track for the balls, strips of screening about 3 in. high being used to form a



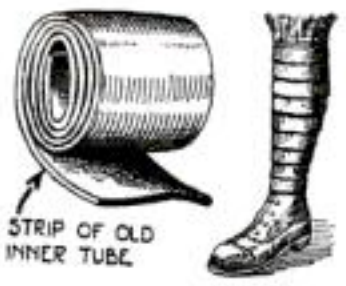
In use, the fans are concealed by the window decorations

fence for inclosing the track. The fence is erected directly on the floor of the window and may simply be tacked in place if a ½-in. edge is turned at right angles.

The blast of air from the two fans keeps the balls moving at good speed, and the fact that they occasionally collide at the intersection only adds to the interest of the display. In dressing the window, it is an easy matter to conceal the fans so that the source of motion remains a mystery. There is no way of guessing that their motive power is air, as long as there is nothing in the window that can be swayed by the air currents.—H. F. B.

Rubber Puttees for Hunters

THE hunter who wades through wet grass for two or three hours with his trousers legs and feet wet is apt to awake the next morning with stiff limbs. Rubber boots prevent this, but they are heavy to hunt in and hurt the feet.



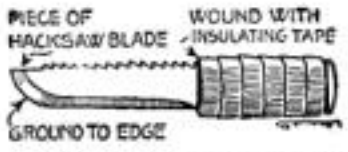
Wound on spirally

One of the best ways to keep dry is to use spiral rubber puttees. These are made by cutting around and around old automobile inner tubes in spiral fashion. A good width for the strips is 2 in.

The upper end of the rubber is simply tucked under to keep the puttees in position.—R. E. DEERING.

Making a Knife for Light Work

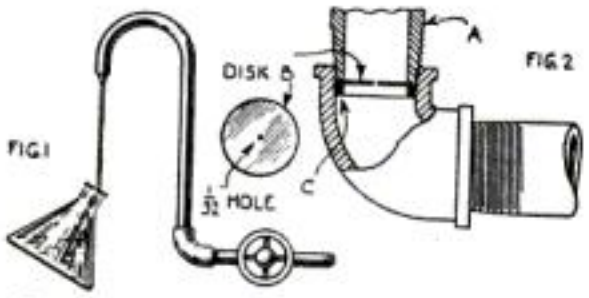
FOR light work, such as stripping insulation from wires, a handy little knife can be made from a piece of broken hacksaw blade about 5 in. long. Wrap two or three inches at one end with friction tape to form a handle and grind the back of the remainder to a knife edge. The saw teeth can be used also for sawing in places where a hacksaw frame would be in the way.—ALLEN P. CHILD.



Utilizing broken hacksaw blade

Cheap Attachment Regulates Flow of Water in the Laboratory

IN THE laboratory, where bottles and flasks constantly have to be filled from faucets and goosenecks, it is desirable that the flow of water shall be in a steady, small compact stream (Fig. 1). Special fixtures



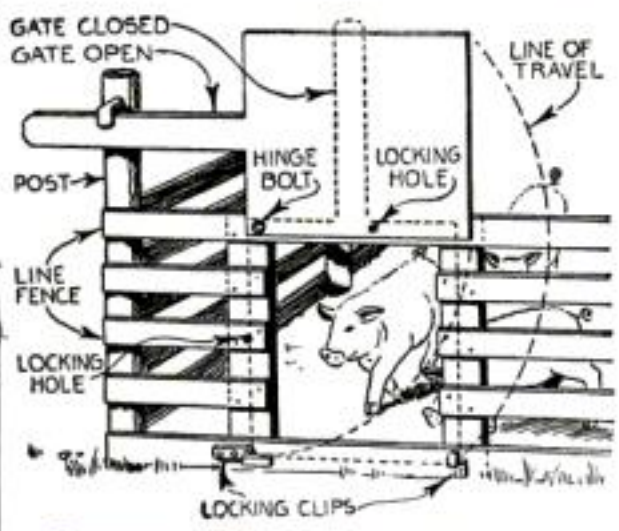
Provides a fine, compact, steady stream

can be obtained to produce this result, but there is also a cheaper way.

Before screwing the gooseneck *A* (Fig. 2) into the elbow, screw in a short bushing, *C*, made by cutting a thin slice from the end of a threaded pipe. On top of this drop a brass disk, *B*, with a 1/32-in. hole drilled in the center. Then screw down the gooseneck tight so as to clamp the disk in place. This arrangement will insure a fine, steady flow of water that will be found ideal for laboratory use.—LESLIE G. ROLLER.

Making a Single Slip-Gap for Small Farm Stock

TO MAKE a gate for the use of small stock, cut a slip-gap in the fence and firmly cleat the loose ends of the boards sawn apart. Having constructed a gate that is several inches larger each way than the dimensions of the gap, mount this gate on a single pivot-bolt through fence and gate near an upper corner of the gate, so that the gate is tiltable in a line with the fence. The fence cleats and the gate are, of course, to be placed on sides of the fence opposite each



Gate may be locked either up or down

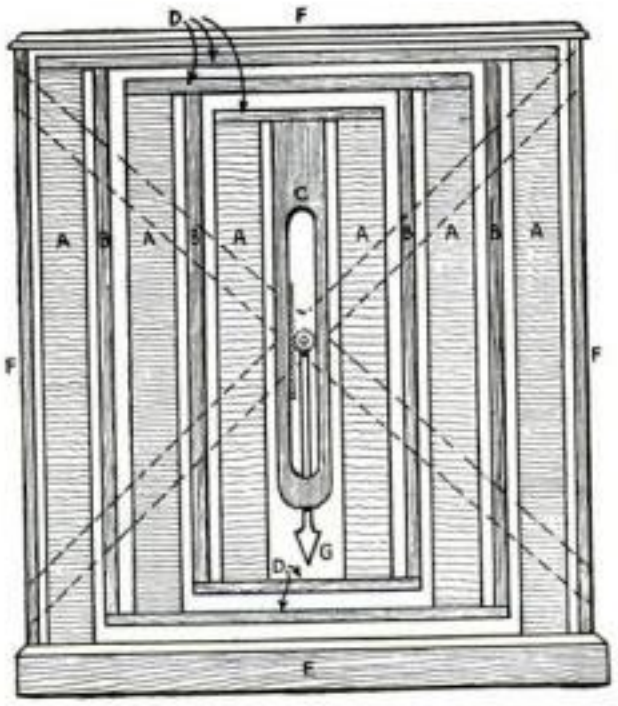
other. The middle board of the gate should be 3 or 4 ft. longer than the main members, so that when the gate is swung up, the end of this long member may be secured under the hook clip on the post, as provided for that purpose. Two other hook clips are provided on the lower board of the fence, positioned so that when the gate is down it will drop into the hook portions, rendering it impossible for stock to push the gate away from the fence at the bottom. Bore a hole through both gate and fence, so that a bolt or pin may be inserted, to serve the purpose of a lock when the gate is down.—LOUIS SCHNEIDER.

Wooden Hygroscope Foretells Wet and Dry Weather

THOSE who are handy with tools and take pleasure in doing neat, accurate woodworking will find the making of this wooden hygroscope an interesting problem. The finished instrument makes a fine looking piece of scientific apparatus and is most interesting to watch in action. It should be noted that while the hygroscope is scientific in so far as it will indicate the weather to be expected, it should not be called a hygrometer, as that instrument registers the percentage of moisture in the air.

Although no particular measurements are specified, since the maker can use his own judgment, 8 by 10 in. is a good size. To preserve the general proportions, the depth from front to back of the uprights, *A* and *B*, should be about one half greater than the width. The outside framework, *F*, should be a trifle deeper, and the base, *E*, considerably more so.

The columns, *A*, are of any clear, straight-grained, soft wood, sawn across the grain. Each pair should be from one piece of wood, sawed in half, so that the grain of each will be similar. The connecting pieces, *B*, *D*, and *C*, are of hard wood, with the grain lengthwise. The outer columns, *A*, are first fastened to the base; the top cross bar, *D*, is then glued and screwed to their upper end; the descending bars, *B*, are fixed to this, and so on until *C* is reached, as shown.



Moisture in the air causes strips marked A to swell, and their expansion is added together and communicated through strips B, C, and D, and rack and pinion to the pointer G

Connecting piece *C* should have a slot down the center, on the inside of which is fastened a rack engaging the teeth of a small cog-wheel. This cog is attached to a spindle, on which is fixed the pointer, *G*. Most workshop junk boxes or attic chests contain the works of an old clock from which the pointer and gear can be taken. The rack can be filed from a strip of brass and fastened on with screws.

Two diagonal braces, represented by dotted lines in the accompanying drawing, may be added to the framework to keep the outside columns in line and to steady the pointer spindle.

The face may be of either wood or metal,

(Continued on page 101)

THE HOME WORKSHOP

Wooden Hygroscope Foretells Weather

(Continued from page 100)

solid, or, perhaps better, made with fretwork or filagree work. The one illustrated is cut from sheet brass and fastened to the framework. The large circle is marked with degrees so that a record of the readings may be kept.

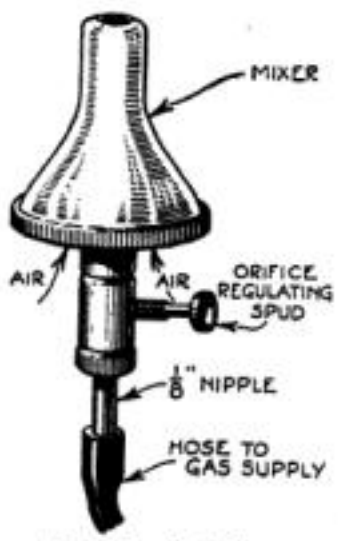
The principle on which the instrument works is this: Moist atmosphere will cause wood to expand more across the grain than with it, and this swelling in the columns marked *A* is communicated through the strips *B* and *D*, to *C*, which, in rising, turns the pointer. The reverse action takes place when dry weather causes the wood to contract again. The movement is in proportion to the sum of the expansion of all three pairs of columns.

As wood absorbs moisture more readily than it discharges it, the instrument seems to give more and longer notice of southerly winds and rain than northerly ones to dry weather. Thus, a small swing of the hand toward "dry" will mean more than an equivalent movement toward "wet." Neither the cross bars at the back nor the face must touch the columns, which should be entirely free in every direction except where the first bar is joined to the base.

Different colored wood may be used and any part of the apparatus painted or varnished as desired, except the columns *A*, which must not be treated in any way.

Blowpipe and Soldering-Torch Made from Gas-Light Burner

WHEN I was about to undertake a certain repair job recently, I found that I had forgotten to include an alcohol blowpipe in the toolkit. In its place I used an air mixer and orifice-regulating spud of an ordinary inverted gas-mantle burner. This I attached to a gas outlet by means of a hose, and it gave a better soldering - flame than the alcohol lamp, much to our surprise.

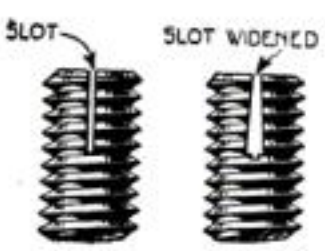


Provides hot flame

This torch or blowpipe is now in daily use and the alcohol torch is reserved for places where no gas connection is obtainable.—JOHN H. SCHALEK.

Hacksaw Slot Takes Place of Cotterpin Hole

IT IS not always easy to drill a cotterpin hole in a small bolt. A substitute method that works very well is to cut with a hacksaw a slot down to where the cotterpin will come. Then slightly saw down the sides of the slot in an inverted V shape. If necessary, the end of the bolt may be pinched. This scheme will work well on bolts as small as ¼ in.—E. MILLER.



Easier than drilling

How to Keep Warm on 30% Less Coal

(Continued from page 32)

our houses, offices, schools, and workshops.

The first step in remedying this condition in your houses, with a view to saving on the fuel bill, as well as improving comfort and health, is to purchase a hygrometer, an instrument to register relative humidity. There are two general types of this instrument. The more accurate type has two thermometers, the bulb of one being inclosed in a water saturated wick. The difference in degrees registered by the two thermometers when compared with an accompanying scale, shows the humidity. The other type is direct reading and operates by the contraction or expansion of a hair under the influence of moisture in the air. One of these instruments will cost five dollars or more, but it should be regarded as a necessary bit of household equipment.

The next step is to devise some method for supplying humidity to the air. A great deal more water is needed for this purpose than is usually supposed. The usual warm air furnace has a water pan in the bottom holding a gallon or so of water, and occasionally some one remembers to fill the pan. But for all the good it does, it might as well be forgotten. A pan of this sort actually supplies less moisture to the air than a human body gives off in a day, and affects the humidity of the house scarcely at all. In order to maintain a humidity of about 50 per cent at 70 degrees in the average seven- or eight-room house, we must evaporate into the air from 17 to 20 gallons of water a day.

Humidifier in Furnace Fire Pot

The best of the modern hot air furnaces has a cast iron evaporating pan on top of the fire pot, inside the furnace shell. This pan is connected by pipe with a tank on the outside of the furnace in which the water level is the same as in the pan inside. A water valve controlled by a float, of the type used in toilet tanks, keeps the tank constantly filled with water. In making such an installation, equip the outside tank with an overflow pipe, so that if the float valve fails to operate, the furnace will not be flooded inside.

A number of types of humidifiers now on the market may be attached to steam or hot water radiators, but careful tests have shown these to have little or no value. The problem of humidity is most easily solved in a steam system, for which there can be purchased a small noiseless and adjustable valve that allows some of the steam to escape directly into the air of the rooms. For the hot water heating system no simple method of obtaining the desired humidity has been suggested.

The following instructions may be safely followed in the operation of any system of heating, and may be profitably applied by any householder:

1. A good draft is essential to proper combustion. Therefore, the chimney should be absolutely tight and the smoke connection as short and straight as possible.

2. A hand damper should be installed in the smoke pipe to regulate the intensity of the draft. This should be installed in addition to any other mechanically operated dampers that may be in use.

3. The heater base should be tight and grouted to the floor to prevent air leakage

(Continued on page 103)

How to Keep Warm on 30% Less Coal

(*Continued from page 102*)

into the ashpit. All flue, fire, and ashpit doors should be filed and fitted to make tight joints.

4. Heating surfaces should be kept clean and free from soot and ash accumulation, and the entire ashpit should be cleaned at least once a day.

5. Grates should be kept in good condition so that they will shake easily and have no broken places for coal to drop through. Unburned or partly burned coal should not appear in the ashes at any time.

6. Steam heaters and hot water piping should be completely covered with a good grade of insulation of ample thickness to prevent heat losses.

7. The firepot should be kept filled at all times. It is a mistaken notion to assume that a low fire effects economy. On the contrary, it is wasteful and extravagant. Do not shake your fires too often, too long, or too violently, especially in mild weather.

8. Regular attention to the fire by one member of the family is desirable.

9. The firepot should have sufficient coal capacity to require attention not more than once in eight hours.

10. Keep your house temperature lowered. Sixty-six degrees should be sufficient for comfort. If you are not comfortable at this temperature, you are not properly clothed, or the humidity in your house is too low.

11. Shorten the heating season as much as possible. Do not start your heater with the first sign of cold weather. An open fireplace or a gas heater should be used.

12. Heat as few rooms as the comfort of your family will permit. A tremendous waste is caused by the heating of unoccupied rooms.

Best Photos Win $50 in Prizes

SOME of the most interesting recent achievements in science and invention are brought to the attention of POPULAR SCIENCE MONTHLY readers this month through the wide-awake efforts of amateur photographers competing in our October prize camera contest. Photographs of the three subjects that won $50 in prizes appear on other pages of this issue.

It's Easy

YOU don't have to be an expert photographer. Just keep your eyes open for some new invention, successful mechanical device, or ingenious engineering feat. Snap the picture, including a human figure in the view, and send the photo in.

Here are the prize-winners in the October contest:

FIRST PRIZE, $25—E. Weiss, Paris, France. Subject—"Quick Change of Wheels Converts Truck into Tractor" (see page 36).

SECOND PRIZE, $15—Frank B. Howe, Los Angeles, Calif. Subject—"Boys Build Self-Propelled Model of Famous Ship"—(see page 56).

THIRD PRIZE, $10—H. F. Blanchard, Tuckahoe, N. Y. Subject—"Mortising Machine Saves Carpenter's Time" (see page 34).

Is Einstein Wrong, After All?

(Continued from page 27)

"Ether House." The interferometer was floated in a container full of mercury, so that it would revolve for hours after being set slowly in motion.

As the interferometer revolved, the observer had to walk around the platform and look into the telescope, making the readings. A thrilling experience followed. THE POINTER DID MOVE. But there was one difficulty—another, unexplained, pointer movement occurred every revolution.

"I cannot say at this time that Einstein is wrong," Doctor Miller explains. "Our experiments indicate a strong possibility, but we must first eliminate the 'error effect.' If the effect we seek is not present when we have eliminated the error effect, then the experiment would indicate that Einstein is right. If we eliminate the error, and the pointer shift stays at each revolution, then we have direct evidence that the ether exists, that the main premise upon which Einstein based his theory is incorrect, and that his theory must be modified."

Meanwhile, by a happy coincidence, the astronomic tests of Einstein's theories are now to be repeated by American, British, German and Dutch astronomers.

These astronomers, already at their eclipse stations, have been taking photographs of stars in the region of the heavens where the eclipse is to occur. On the day of the eclipse, and during the nearly six minutes that the moon will completely hide the sun, photographs will again be taken of these same stars as they show around the edges of the obscured sun. If, in the latter photographs, stars near the sun do not seem to be in the same position as they do in the earlier pictures, it may be assumed that their light, passing close to the sun, was so bent by solar attraction as to produce an apparent displacement. If this result, confirming the earlier one of 1919, is obtained, the Einstein theory will have pretty firm foundation.

Prize-Winners in July and August Puzzle Contests

WINNERS of prizes for the best solutions of the Sam Loyd puzzles appearing in the July issue are:

FIRST PRIZE, Ten Dollars: Geo. C. Hill, Washington, D. C.

SECOND PRIZE, Five Dollars: K. T. Redick, Newington, Conn.

Ten One-Dollar Prizes:

H. Maire, Fort Lee, N. J.; J. H. Wickham, Jr., Cincinnati, Ohio; John Kinzer, Brooklyn, N. Y.; Art C. Engstrom, Two Harbors, Minn.; C. E. Mallory, Waupun, Wis.; Ernest R. Lowe, Waltham, Mass.; Shelby H. Senteney, Thebes, Ill.; Mrs. Leota Killian, Ilion, N. Y.; Herbert F. Fitton, Quincy, Mass.; Eva E. Ropes, Detroit, Mich.

PRIZE-WINNERS FOR AUGUST

FIRST PRIZE, Ten Dollars: R. G. Jansen, Des Moines, Iowa.

SECOND PRIZE, Five Dollars: Fred G. Shoner, Fort Wayne, Ind.

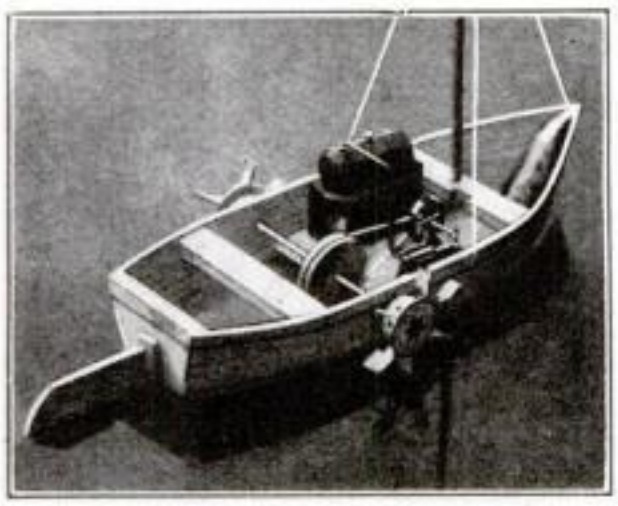
Ten One-Dollar Prizes: Francis H. Ale, Pittsburgh, Pa.; A. G. Kalmbach, Grand Rapids, Mich.; George Clahane, Concord, Mass.; Paul L. Sullivan, Flushing, Long Island, N. Y.; J. E. Roberts, Durham, N. C.; O. E. Buker, Canton, Ohio; Miss S. Ireland, Edmonton, Canada; W. H. Gaines, Mobile, Ala.; J. S. Huske, Fayetteville, N. C.; Mrs. L. H. Carder, Arkansas City, Kans.

THE HOME WORKSHOP

Toy Steam Engine Propels Small Model Side Wheeler

A UNIQUE use for the small toy steam engine is to install it as the power plant of a model side-wheeler steamboat.

The boat should be flat-bottomed and comparatively wide. One good way to make it is by constructing a wooden frame and covering it with tar paper, as described on page 74 of the September POPULAR SCIENCE MONTHLY. Another way is to build it entirely of wood. In that case, the bottom, stern posts, bow stem, and the two braces, all of which can be seen in the accompanying photograph, are cut from a



A steamboat so simple in construction that any boy can build it

½-in. board. The two sides are made from thinner wood, the sides of a cheese box being especially suitable.

While cutting the bottom, place the two thin sides in a tub of water so that they may become thoroughly saturated. See that the base is wide enough to accommodate the engine. The front and bow are then attached to the bottom, and the two side pieces, now being pliable, are bent to the shape of the frame and tacked on. After they are attached, saw off the surplus wood.

Two holes are bored in the sides of the vessel to suit the shaft, which is simply a piece of stout wire. It should be about 2 in. longer than the width of the boat. To this shaft is fastened firmly a pulley, the size of which will depend upon the engine. It must be large enough so that it will turn not more than once for every ten revolutions of the flywheel. The larger the pulley, the better the engine is apt to work.

At each end is attached a disk of wood to form the hub for the paddles. These are made from odd pieces of tin or an old tin can. First cut a circle, divide it into 6 parts, and then cut out the six paddles. They are attached to the wooden disks, as shown. Care must be taken to see that the paddles do not go too deeply into the water. The best results will be obtained if they do not enter the water more than ¼ in.

A mast can be attached, if desired, and a superstructure or other details added to suit the maker. All that then needs to be done is to paint the boat with a good white lead paint.—E. B.

Resurfacing Worn Oilstones

THE method of resurfacing worn oilstones, used by most toolmakers, is to sprinkle some coarse emery on a flat metal surface, such as a bench plate, and rub or slide the oilstone over it until it is reconditioned. This leaves the stone perfectly flat and gives it a cutting quality equal to new.—H. P. BOETTCHER.

THE HOME WORKSHOP

Railroad Iron Makes Small Anvil

A LIGHT anvil suitable for small work is frequently useful in the home workshop, and one can be made without much trouble from a piece of heavy railroad iron.

The one illustrated was roughed out on a power hacksaw and finished by hand on an emery grinder, the top being planed off to make a flat working surface. It is screwed to a heavy wooden plank, to the bottom of which is fastened a cleat. This permits the anvil to be set up in the bench vise at a moment's notice.

Anvil with vise attached

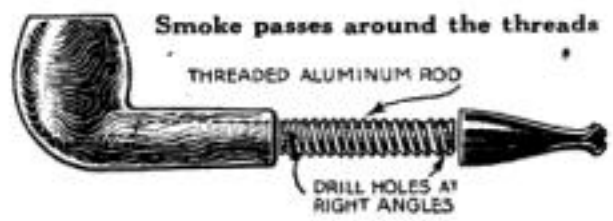
The usefulness of the anvil shown was extended by welding to it a small hand vise that extends a little above the top surface.

A piece of 60-pound rail was used for the anvil, which is 12 in. long, stands 4 in. high above the base block and weighs 12 pounds.—F. M. W., JR.

How to Make a Cool Smoking Short-Stemmed Pipe

ALL pipe smokers know that a long-stemmed pipe gives a cool smoke but is awkward to carry and is undesirably conspicuous. A short-stemmed pipe can, however, be altered with little difficulty to give the same coolness.

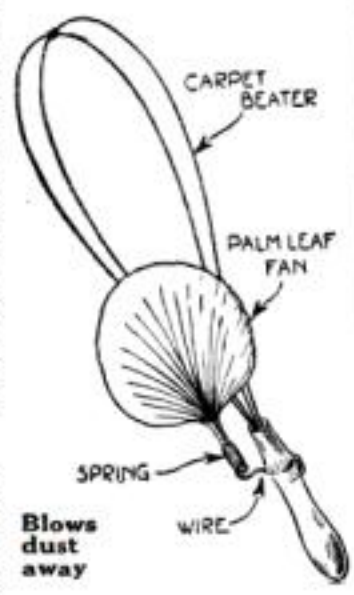
Select a pipe with a straight stem and a very short mouthpiece. Remove the



mouthpiece and drill a hole into the stem and bowl that will take a piece of aluminum rod. Have the rod threaded throughout its length and tapped at one end to suit the mouthpiece. Cut it off short enough to allow the mouthpiece to come flush with the stem. The smoke will then be forced to travel around the thread before it enters the mouthpiece.—EDWARD G. GETTINS.

Fan Improves Carpet Beater

TO DRIVE away the dust while beating rugs and prevent it from rising in my face, I fastened a fan to the handle of the carpet beater by means of an open coil spring about 3 in. long, made from No. 12 gage wire. For making a hole in the handle, I used a wire nail, the point of which was hammered to a chisel edge so that it would not split the wood.



The handle of a palm-leaf fan was tapered a trifle and notched roughly so that it could be screwed into the spring far enough to hold firmly.—G. M. BEERBOWER.

Voices Across the Atlantic

(Continued from page 64)

readers of POPULAR SCIENCE MONTHLY to learn that much of the preliminary work has already been done at Radio Central, the gigantic radio station at Riverhead, L. I. This station, when completed, will be the most powerful in the world, and will be able to carry on direct communication with almost all parts of the world.

Undoubtedly it will be one of the first to establish continuous transatlantic telephony. The preliminary work that has already been carried on there has been done by two separate corporations in cooperation with the Radio Corporation of America. One of these two companies has been experimenting with power vacuum tubes of 20 kilowatts output each, and the other with tubes of 10 kilowatts, both using tubes in parallel to build up the desired amount of radiation energy.

I am reliably informed that an antenna energy of 25 kilowatts has already been obtained in the antenna system at Radio Central from the bank of 20 kilowatt tubes.

The Radio "Flivver"

HAVE we got the "flivver of radio" in the single-tube Armstrong super-regenerative circuit?

In my opinion we have, and with this opinion E. H. Armstrong agrees. He stated it specifically when he gave a demonstration before the Radio Club of America at Columbia University recently.

At the conclusion of the demonstration, Armstrong said that one of the possible developments of the single tube circuit would be to have the tube perform the functions of regenerator and oscillator, and then have a rugged crystal, permanently fixed, operate as the detector.

In this way a set could be constructed with a standard loop aerial, and set permanently at 360-meter wave length adjustment, so that all the radio fan would have to do would be to press a button and turn the loop toward the broadcasting station.

The crystal in this case could be carborundum, and it could be permanently set, because of the tremendous amount of energy that would be supplied to it by the super-regenerator. A single stage of audio-frequency amplification, also permanently adjusted, would then give loudspeaking results. This idea is perfectly feasible.

Government Radio

(Continued from page 67)

conditions; and this means high power—much higher power than is used at present. In Europe it has been demonstrated that powers of one kilowatt and upward must be used to *insure* successful transmission over a distance of 100 miles or a little more. In this country, 15-watt sets have been heard 1000 miles, of course, but this is 'freak' reception.

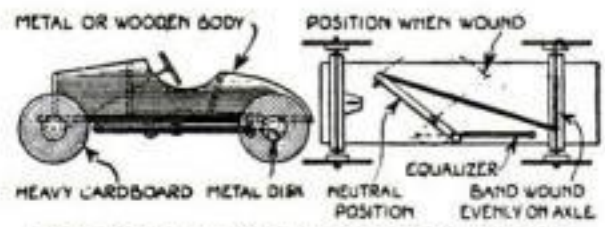
"These are some of the reasons why I believe government broadcasting will be the only finally successful plan.

It is an almost staggering vision of public service that Mr. Howell sees as the ultimate goal of broadcasting. And if he is elected to the Senate this fall, we shall have one real radio man in Congress, and one who frankly states that he will put up a fight for the great government broadcasting system in which he believes.

THE HOME WORKSHOP

Toy Cycle-Car Is Propelled by Unique Elastic Drive

RUBBER bands fastened in an unusual way are the motive power of this cycle-car. By revolving the left rear wheel in either direction, one rubber band is wound evenly on the axle. The lever does not move until the axle is half wound;



This toy auto runs backward or forward

then it gradually swings around on its pivot. The toy I made on this principle runs 25 ft.

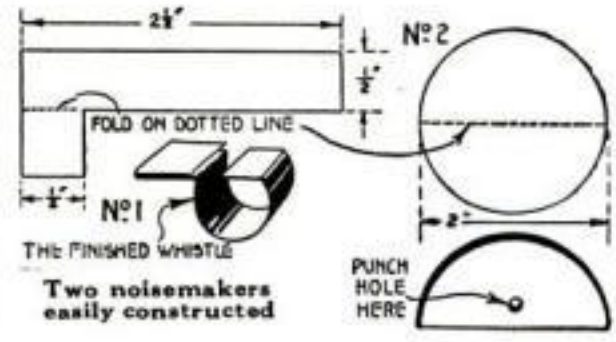
The chassis is a piece of ⅛-in. thick wood, 3 by 12¾ in. The body may be either of wood or thin metal. The wheels are either metal disks or heavy cardboard attached to sections of 1-in. curtain poles. The axles are of wire.

Two elastic bands about ⅛ in. wide are necessary. The one attached to the axle is cut and stretched full length. The equalizer is used double.—DONALD W. CLARK.

Making Simple Tin Whistles

TO MAKE whistles that will delight the heart of any boy requires but a few minutes' time, a piece of tin, and a pair of snips or old shears.

Whistle No. 1 gives a very shrill, clear note. Cut the tin by the L-shaped pattern and fold over the lower part on the dotted line. Leave about a 1/16-in. space between the two leaves. The stem of the L should



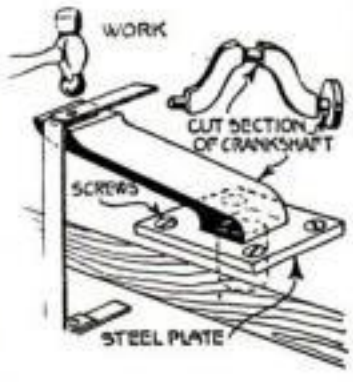
Two noisemakers easily constructed

be curved so that this end comes to within about ⅛ in. of the folded part. When the whistle is to be blown, the thumb and forefinger close the space on each side of the circle, forming an air chamber.

Nearly every one is familiar with whistle No. 2, on which tunes can be played. A circle of tin is cut and folded over as shown, and a nail hole is punched through. The double semicircle thus formed is held between the lips and the tone can be varied by pressing the tongue against the folded edge.—GLEN F. STILLWELL.

Crankshaft for Benchstake

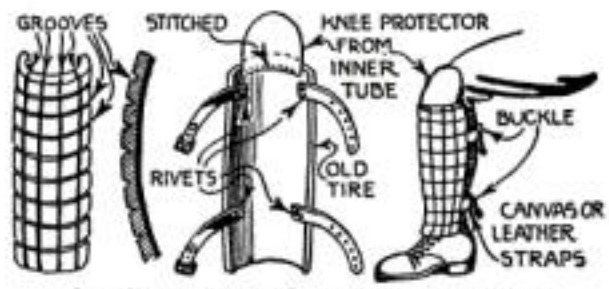
FROM a section of an old Ford crankshaft, it is possible to make a useful benchstake for light work. The crankshaft is cut as shown and fitted into a plate screwed to the bench.—C. H. W.



Football Shinguards Made from Old Automobile Tires

THIS idea grew out of an emergency. Before a football game a number of players were shy of shin protectors and the cost of buying them was so great that I tried out the possibility of making guards from old automobile tires.

In order to have them as pliable as possible, I cut V-shaped slits ¾ in. apart on



Combine strength with considerable flexibility

the face of the tire. The straps were made of 14-oz. canvas doubled and sewn, although leather straps would have made an even better job. Small iron buckles were used for fastening the straps.

The knee protectors were cut from an inner tube and given an outside covering of canvas, which was reinforced with No. 20 wire stitched around the edge and vertically.—GEORGE R. AUGER.

Blowing Up a Football

EVERY boy who has tried to blow up a football or basketball knows the need of a special fitting for making the connection. A fitting that will serve the purpose can be made in 10 minutes with a file.

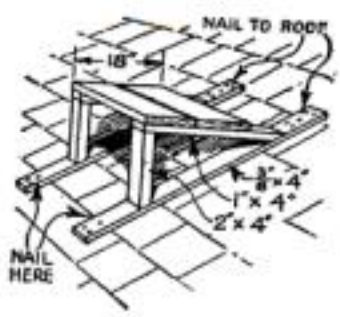
Obtain a valve stem from any discarded automobile tube; saw or file off the base or part that attaches to the stem of the tube, and then file the same end of the stem to the tapering shape shown in the illustration. The two grooves are not absolutely necessary, but help to prevent the rubber tube from slipping off the valve.

Attachment made from valve stem

Screw the threaded end into the air-pump connection, push the tapered end into the tube of the football bladder and then pump. The check valve in the stem prevents the air from escaping, and leaves both hands free to double over the tube and tie it.—L. C. MACDONALD.

Bracket Staging for Roof

THIS roofing bracket is supported on two ⅜-in. pieces. The uprights are 2 in. by 4 in. and are nailed to the thinner boards from underneath; they can also be toe-nailed, if it is thought necessary. The nails used are rosin-coated and their holding power is exceptional. The cross piece may be 1 by 4 in. or 2 by 4 in. The width of the complete staging is 18 in.



Supports roofing scaffold

The upper and lower ends of the ⅜-in. pieces are tacked to the roof. One pair of the brackets support the scaffold boards and another pair should be handy so that they can be put in place higher up before the first pair is removed.—R. P. L.

Making Clear Leaf Prints with Carbon Paper

IN STUDYING botany, it is necessary to make permanent records of the form of various leaves. To do this by means of freehand drawing requires considerable skill and patience. Prints taken directly from the leaves are easier to make and contain more detail. No elaborate apparatus is necessary, because the printing can be done with ordinary typewriter carbon paper.

Prints of elder and maple

When perfect specimens of the desired leaves have been obtained, place one of them on a sheet of paper, resting on some soft surface such as a magazine covered with a piece of cloth. Next, lay a piece of carbon paper on the leaf, carbon side down. Place another piece of paper over it and press down heavily with a gas or electric iron, heated but slightly. Move the iron back and forth gently a few times. In a minute or two sufficient ink from the carbon will have been transferred to the leaf so that it can be used to make a direct print.

Now take a good grade of paper or bristol board and lay it on the cloth-covered magazine. Place the leaf in position upside down upon the paper and press it down with the warm iron. This will transfer a positive print of the leaf to the paper and will show clearly the edges, serrations, and venations.—B. E.

Aspen and oak leaves

Making Putty that Will Stick

A PUTTY that is said to stick like glue in a nail hole or crack may be made by mixing together two or three handfuls of plaster of Paris and a little paint, preferably of the color to be used on the woodwork. Knead these up like putty, adding more plaster if the mixture is sticky. This sets quickly and becomes very hard.—R. L.

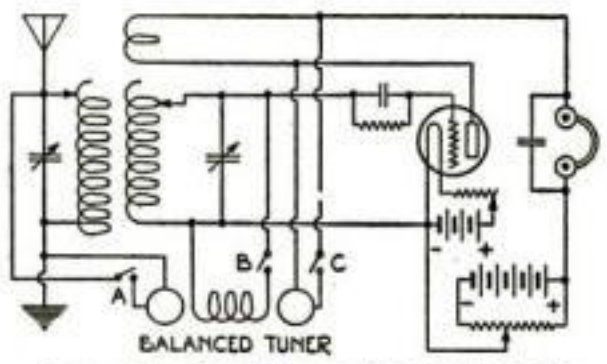
THE HOME WORKSHOP

Ford Panel Switch Permits Quick Change of Radio Circuits

By J. M. Rolston

IN CHANGING from short to long wave reception I make the necessary circuit adjustments in my radio set quickly and easily by using a Ford panel switch. This permits me to use a variocoupler type of tuner for broadcasting, and various sizes of honeycomb coils for the long wave stations. The accompanying diagram shows how the circuits are arranged.

For the short wave balanced tuner I use honeycomb coils Nos. 25, 35, and 50. The wiring from the No. 35 coil was removed



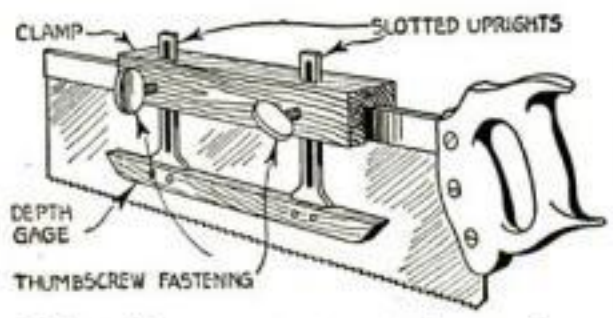
A combination long and short wave set

and wound around a composition tube 3 in. in outside diameter and 5 in. long, which forms the secondary. (This could have been accomplished more cheaply by winding on a corresponding amount of magnet wire instead of using that taken from a purchased coil.) Inside the tube I mounted a No. 25 coil to form the primary and a No. 50 coil to form the tickler, the connections being made by means of brass brushes bearing against collector rings mounted on the coil shafts.

The hook-up is so arranged that a Ford panel switch button (A, B, and C) is in series with each of the tuner coils; they can be cut in at will. When this tuner is in service for broadcasting, no honeycomb coils are plugged in the regular honeycomb coil mounting on the outside of the panel; but for long wave reception the balanced tuner is cut out by means of the push-buttons and the necessary honeycomb coils are placed in the outside mountings.

Depth Gage for Backsaw

OF MANY types of depth gages for backsaws, one of the most convenient and one that can easily be constructed by



Adjustable gage prevents cutting too deep

the home worker from strips of hard wood, is that illustrated.

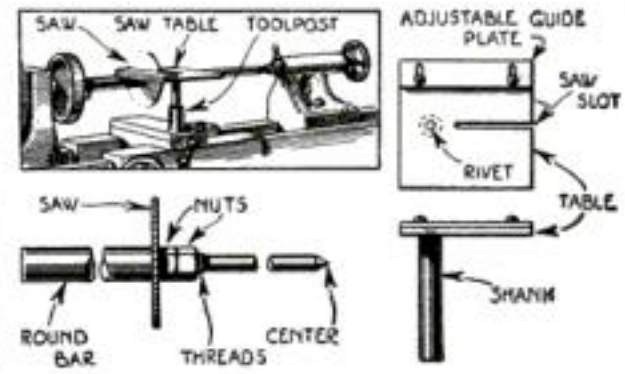
The clamp is slotted to fit over the back of the saw. The slot is recessed at two places to take ¼-in. square nuts, which do not turn but serve as bearings for the two thumbscrews. These engage the slotted uprights, to which is fastened the depth gage proper.

Not only can the gage be raised up and down instantly, but it can be removed when not needed.—JOHN M. PIPP.

THE HOME WORKSHOP

Attachment for Light Sawing on a Bench Lathe

A USEFUL saw attachment for cutting small pieces of metal and fiber on the lathe is easily made. A round bar is turned down to fit into a circular saw,



How the attachment is made and used

which is fastened to it with two hexagonal nuts, as shown. The table is riveted to a shank and that is held by a setscrew in the toolpost. Slots are provided for adjusting the guide plate.—FRANK HARAZIM.

Made $456 in a Month Digging Wild Horseradish

By C. O. Soots, North Salem, Ind.

(Submitted in the contest, "How I Made Money with My Tools")

MAKING a neat little extra income by digging wild horseradish may hardly qualify under the terms of the contest, "How I Made Money with Tools," especially since the tools I used were only a spade, grubbing hoe, and hatchet. But the idea itself is perhaps novel enough to interest readers of POPULAR SCIENCE MONTHLY. My scheme can be worked profitably seven months of the year, although October proved my banner month.

Hiring a man to drive me through the rural districts in his car, I would stop at every house and inquire if there was any volunteer (or wild) horseradish in the neighborhood that needed to be dug up and killed. About one farmer in ten has a field partly covered with it and it seems that every person knows of a patch if he has none on his place. I would find the patch and then make a deal with the owner. Sometimes I would get paid by him for digging it; on other occasions I would have to pay the owner and then again he would say: "Dig it and take it." The result was about the same in the end, for I was selling it for eight cents a pound at various canning factories. When I found a large patch, sometimes a ton in one place, I would hire two men to help dig. When three of us were digging, we could sack anywhere from eleven to fifteen hundred pounds of horseradish a day.

I have never failed yet to make a good day's wages when I have worked at it. The work itself is very simple, for any one can set the spade back three or four inches from the top of the root, push the spade down as far as it will go, then pry up. The root breaks off, but you have the larger part. Cut the green tops off with a hatchet, sack the roots without washing them, and they are ready for shipment.

My best month I dug and sold, with the help of one man, 5700 lbs. at eight cents a pound, or $456 worth. Most of the canning factories and commission men will buy the horseradish and are glad to get it.

THE HOME WORKSHOP

Printing Box for Photographers Works almost Automatically

By Herbert C. McKay

PRACTICALLY an automatic system of printing for the amateur photographer is provided by this printing box. Among its advantages are an automatic light switch, positive contact with even the smallest prints without danger of slipping, printing surface at a convenient angle, easily adjusted masking leaves, and fixed registering guide.

The important points of construction are lettered for clearness. The contact plungers may be purchased at any electrical store, or old fashioned window bolts may be used. For a white light a nitrogen bulb with concentrated filament is best. If two bulbs instead of one large bulb are used, they should be placed so that both are the same distance from the back board. The most important point is to see that the filaments are equally distant from both the front and

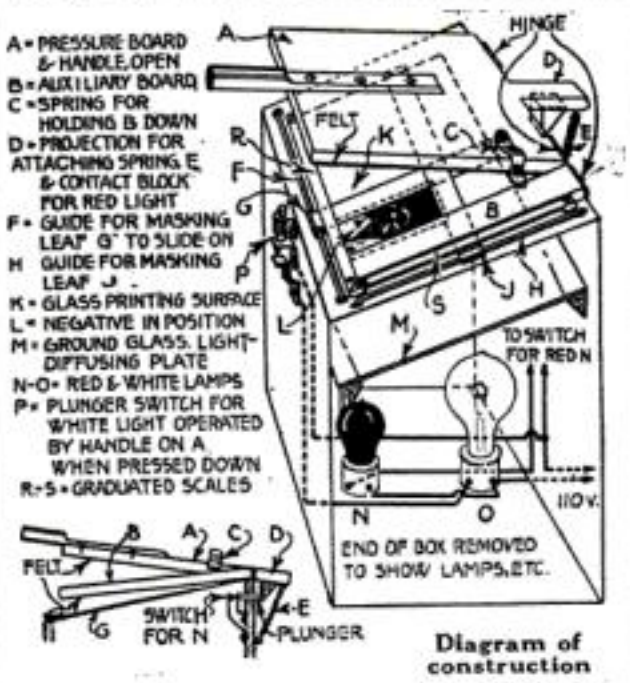


Diagram of construction

the rear of the printing surface so as to give the same effect as a centrally located light would give with a flat printing surface. Any other arrangement will cause uneven illumination of the prints.

The spiral spring *E* attaches to a rear projection of the pressure board and tends to hold it open. A flat spring *C* operates the auxiliary pressure board *B*, which descends and grips the film and paper, holding them correctly registered, while the main pressure board is still 1 or 2 in. above the paper. This allows the fingers to be withdrawn without danger of the film and paper slipping.

The vertical masking leaf *G*, made of thin metal, slides on the guide *F*. The horizontal masking leaf *J* slides on its guide *H*. At the lower left-hand corner the registering guide, which is a sheet metal angle, is set back 3/16 in. from the printing opening so as to make a permanent 3/16-in. mask. The movable leaves are adjusted to fit the particular negative in hand.

When the pressure board is up and the printing surface exposed, the red light is on. The film and paper are adjusted on the glass over the registering guides and masking leaves and held in place while the handle of the pressure board is pressed. When the board is closed, the red lamp is automatically turned off, and the white light, operated by the plunger switch in front, goes on. The light, diffusing evenly through the ground glass *M*, which makes the print, remains on until the pressure board is raised.

Wirelesss Code Transmitter

(Continued from page 74)

by a tension arrangement to keep the film drawn taut. This tension is provided by means of a central washer made from the metal end of an old film spool and part of an old watch spring. This carrier is about on a level with the receiving spool, No. 4, Fig. 2. The receiving spool is a ½-in. brass tube, the same width as the film, with brass disks for end pieces. The outer one is fastened with a thumbscrew. The inner one is soldered fast to the other end of the tube and is provided with a hole that permits of its being forced on the long clock spindle that carries the minute hand.

Carpet Binding Makes the Contacts

The two contact pieces, Nos. 5 and 6, Figs. 1 and 2, are pieces of brass bent into U shape. They were actually cut from a section of old carpet binding. Number 5 is soldered at one end to an L piece of brass that is screwed to the baseboard; No. 6 is soldered to a brass hinge of such a length that the two pieces, Nos. 5 and 6, will be on the same level. This permits No. 6 to be moved forward or backward so that the contact piece No. 12 can be made to engage the film. The two rounded edges of Nos. 5 and 6 will face each other.

It will be seen from Fig. 1, that the film is threaded from the carrier, No. 3, beneath the spool marked No. 4 (marked in Fig. 2), up between the contact pieces, Nos. 5 and 6, to spool No. 4, where it is wound. Number 7, Fig. 2, is a metal plug that makes contact through the board and when removed disconnects the receiving part at such times as the sending key, No. 1, Fig. 2, is being used.

Number 13, Fig. 2, is the winding key. Number 11 is the brake to start and stop the motor. It is made of ¼-in. spring brass pivoted about 1 in. from the end. This short end is bent in to make contact with one of the wheels as the long end is raised or lowered. Number 12, Fig. 3, is a piece of heavy brass ¼ in. wide, bent U shape so that it will slip over the edge of No. 6. To one end of it is soldered a piece of flattened brass wire, at the free end of which is pivoted a thin brass wheel about ¼ in. in diameter. It is this wheel that drops into the holes in the film as the film is drawn under it, thus making contact with No. 5. The U piece, No. 12, is provided with a set screw to hold it in place.

Alarm Clock Winds the Film

The motor power is supplied by an old alarm clock movement, No. 2, Fig. 2. The alarm mechanism, balance fork, and escapement wheel are removed and a fan, No. 8, supplied to regulate the speed. This fan may be brass or wood; it is geared to the wheel that meshes with the escape pinion.

To make a record on the film, a punch, No. 15, Fig. 3, and a spacing wheel, No. 16, which can be obtained for 10 or 15 cents each, are used. The punch was altered so that it makes a rectangular hole, the thickness of which is equal to the space between teeth on the spacing wheel. In recording a dash 3 holes are punched together. One hole represents a dot.

Before beginning to punch a length of film, the film should be stretched out on a board, and by means of the straight edge

(Continued on page 115)

Wireless Code Transmitter

(Continued from page 114)

and the spacing wheel, a line of dots made as a guide in properly locating the dots and dashes. The dry cell, No. 9, Fig. 1, is held in place by 2 wide, flat springs, so that it can be removed.

Staggered Steps Make Stepladder Safe and Easy to Ascend

THE difficulty of ascending and descending a very steep flight of steps such as are frequently found in towers, shops, stores, and sometimes in houses, is lessened by constructing a ladder with two rows of narrow steps, as shown in the accompanying illustration. This accomplishes the same results as decreasing the rise, without

Useful where steep flights are necessary

causing the corresponding interference and awkwardness that would result if each of the steps was carried right across the ladder.

With this arrangement, it is easy to carry objects up and down, even if both hands are occupied. The idea should, therefore, be of particular value in stockrooms.—T. J. T.

Protector for Draftsman's Scale

CLEARANCE to prevent the graduations and figures of a triangular scale from being worn off by constant friction, may be obtained by fastening to each end

To prevent the graduations wearing off

of the scale a protector of sheet brass about 1/16 in. thick.

Shape the pieces with a fine file, taking care to leave them large enough so that they will project about 1/32 in. all around when finished. Remove all sharp edges and fasten the pieces on with escutcheon pins or small screws.—ALEXANDER GRABAU.

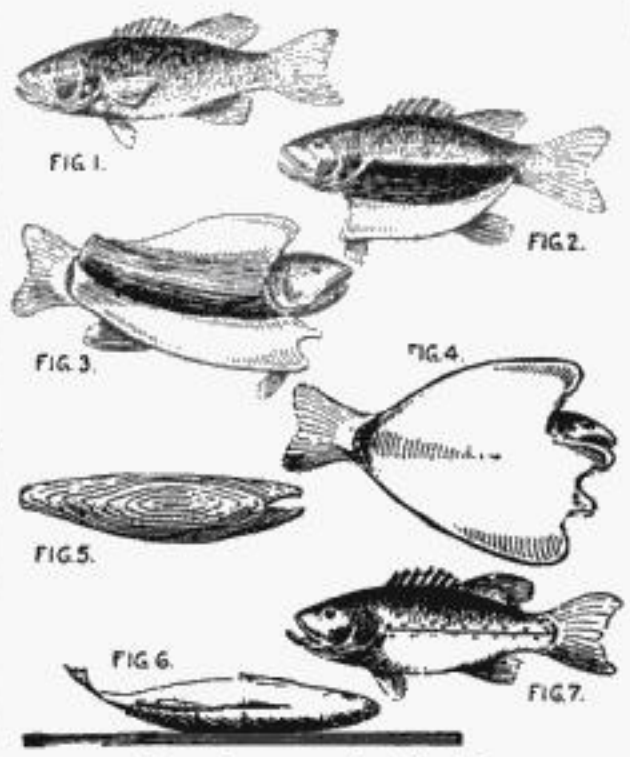
SMALL particles of copper produced by the sliders of radio tuning coils as they slide across the wires are liable to accumulate until they short circuit the turns. It is a good idea to use a fine brush occasionally to rid the coils of particles.

How to Mount the Big Catch of the Season

By Robert Page Lincoln

AUTUMN is the time when the big fish bite and when your chances are good for catching a prize-winner. When you have made the big catch, mount it, and it will be one of your treasured possessions.

It is not difficult to skin the small-mouth bass (Fig. 1). This is an excellent fish to start with, as its skin is very tough. Keep the fish moist by wrapping it in a damp cloth until you are ready to skin it. First, cut along the lateral line from gills to tail, working down gradually and taking care not to disturb the scales (Fig. 2). Keep your fingers wet. Sever the tail bone as in Fig. 3 and remove the skin entirely, as in



Steps in preparing the fish

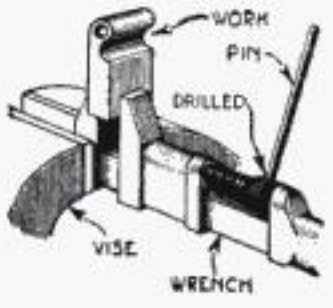
Fig. 4, leaving the bone of the skull in the head skin, as shown.

Instead of following the old method of filling the skin with sawdust, carve a body from a solid piece of wood (Fig. 5). You will have the fish body to guide you and therefore will have little difficulty in whittling out the shape. Stretch the skin over this form and tack it along both edges, as shown in Fig. 7. The mounted fish can then be screwed to a panel of golden birch or other wood, as shown in Fig. 6. Glass eyes can be obtained from any taxidermist, and a pin in the fins will keep them up.

If oil colors are available, the specimen can readily be touched up where necessary. These directions, if carefully followed, will give results resembling the work of a professional taxidermist.

Use Wrench for Small Vise

HAVING to do considerable work on some minute machine parts, and with no vise with jaws small enough to handle them, I drilled the thumbnut of an ordinary monkey-wrench to take a short pin for tightening it and then clamped the head of the wrench in my large vise. I found that the improvised vise speeded up the work to an unexpected degree.—O. S. L.

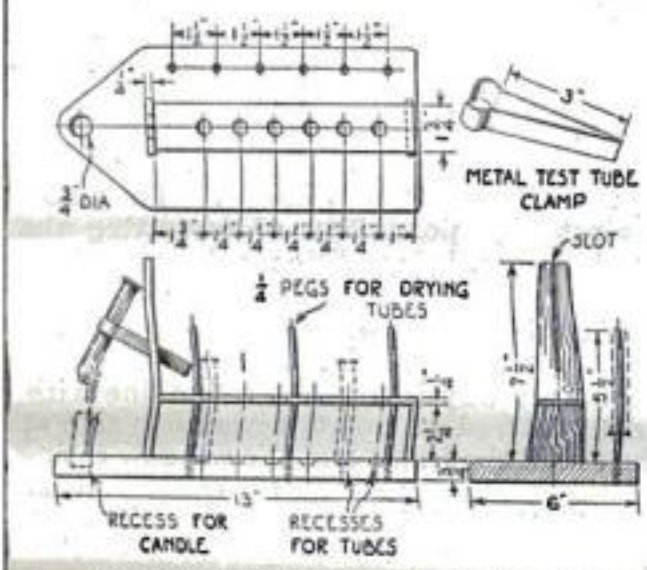


THE HOME WORKSHOP

Test Tube Rack Facilitates Small Chemical Experiments

FOR the boy who has a small chemical set, or for high school or college students of chemistry, this test tube rack will be found most useful. In addition to the usual test tube support, it has a very simple but effective holder for clamping a test tube over a candle or alcohol lamp flame.

A vertical wooden standard at one end of the rack has a slot that takes a clamp of thin metal. When it is desired to heat a chemical, the test tube is placed in the clamp and the clamp is slipped into the slot. This serves to hold the test tube firmly and at the same time permits it to be adjusted in



Top, side and end views of the rack

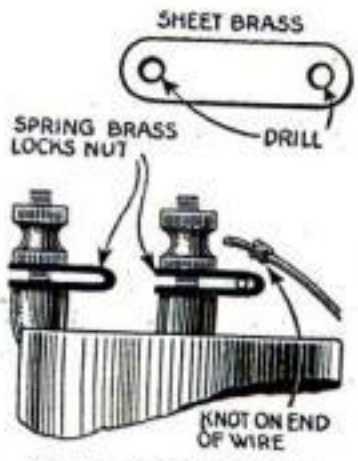
any desired relation to the flame. The rack has six sockets for holding test tubes and six pegs to support them when being dried.

The details and dimensions are given fully on the accompanying drawing. The strip of metal for the test tube clamp may be of either spring brass or tin, about No. 25 gage, ½ in. wide, and about 7⅝ in. long before bending. The bend should be to a radius of about 3/16 in.

By making a few jigs or patterns to facilitate laying out and boring the parts, a manual training class can quickly make a sufficient number of these test tube racks to provide one for each student in the chemical laboratory.—HERBERT A. STRICKLER.

Easily Detached Terminal Connection Locks Nut

THE terminal connection illustrated is suitable for battery or spark plugs, and can quickly be made from sheet brass. It will not only hold the end of a wire in place, but will permit its being quickly detached.



How the connection is applied

Screwing down the terminal nut clamps the end of the wire solidly and at the same time the spring brass ends to keep the nut from working loose. Twist the end of the bare wire several times or tie it in a knot to keep the strands from fraying.

Using this method on dry batteries for a motor car has shown that it prevents nuts from loosening under the vibration of the engine.—G. A. L.

The Shipshape Home
How to Do the Odd Jobs

Marking Screens

WHEN window and porch screens are taken down in the fall, they should be marked in some way so that they can be readily replaced the following season. There are a number of good methods for accomplishing this.

One way is to punch marks on the top or the bottom edge of each screen with a screwdriver or chisel, following a uniform system throughout. For instance, the windows are numbered from left to right on each side of the house, so that a frame marked I-I-III would mean the screen belonging to the third window on the first floor front, the first number representing the front of the house, the second the floor, and the third the window. To guard against any possibility of forgetting the combination, it is well to mark some of the window frames to correspond and those marks will readily provide the key for the whole system of marking.

Another way is to make a fine line with bright colored oil paints across one side of the top of the frame and the window casing into which it fits, varying the colors and the combination of lines. These marks need not be obtrusive, but they will, nevertheless, make it easy to replace the screens.

Still another way is to tie together the screens for each room and label each bundle with a stout tag.—L. R.

Mixing Oil Stains

WHEN a small quantity of stain is needed for woodwork around the house, it can often be made quite satisfactorily at very small cost with boiled oil, turpentine, and powdered colors. A little experimenting will have to be done to get the exact tint required, but it is possible in this way to make an almost unlimited range of tints and shades.

Suppose it is desired to change a light oak flower stand to dark oak to match the trim of the window near which it is to be used. Mix up a little stain composed of boiled oil, raw sienna, and raw umber, thinned with turpentine. The addition of a little burnt sienna will give a color that has more red in it. In fact, with these three colors, which are very cheap, almost any variety of brown and reddish brown may be obtained.—M. R. O.

Covering Steampipes

IT IS not difficult to refinish the asbestos covering on steampipes so that it will be as good as new. First remove the dirt from the old covering and re-cover with strips of rosin-sized building paper cut so that edges will overlap 1 in. A convenient length for the sections is 10 ft.

Then cut strips of 6-oz. canvas or unbleached muslin so that the edges will just meet around the pipe. With an upholstery needle or a darning needle that has been heated and bent and ordinary white string sew the edges together. Give the covering a good coating of cold water paint.—ALBERT S. RUEHL.

THE HOME WORKSHOP

The Shipshape Home

Hanging Wallpaper

THE task of hanging wallpaper can be made easier if the few kinks that are given below are used.

As a guide for the newly pasted strip, stick a common tack or pin at the edge of the preceding strip near the bottom. By allowing the thumb of the left hand to serve as a pivot, the paper will swing into place without much trouble. You can then concentrate your attention on matching the pattern, if that is necessary.

After the two edges have come together, press lightly against the paper with the right hand; it can then be smoothed down. In this way the paper will not be damaged by your efforts to shove it into place or by one strip running over another.

Most wrinkles in wallpaper are caused by not letting the paste soak sufficiently into the paper before it is hung. In the corners the paper should be cut, because it will stay fast much better than if it is folded. Do not let the room get too warm until the paper is dry.

To make flour paste, mix 2 lbs. flour, 1 qt. cold water, and 1 oz. alum previously dissolved in hot water, and add to ½ gal. boiling water. Continue boiling until the paste is a semi-transparent mucilage.

Preparatory to papering it is well to coat the walls with glue size. If the walls are in very bad condition, put some brown sugar or molasses in the paste. When pasting, brush out the paste well at the edges of the paper.

A bed caster will serve as a roller for pressing the seams and a clothesbrush can be used for smoothing out the paper. If the woodwork is to be painted, let the repapering wait until after that is done.—FRED R. MOORE.

Opening Stuck Sash

DOUBLE-HUNG sash sometimes sticks badly, especially just after a house has been painted. Often a lower sash can be opened simply by pulling out the sash cords on both sides and letting go of them suddenly. This lets the weights drop and usually jars the sash loose the first time it is tried.—L. W. FARINHOLT, JR.

Harmony in Hardware

IN SELECTING hardware for the house or for pieces of home-made furniture, it is well to remember that certain finishes and styles of hardware harmonize with certain classes of woodwork. The effect of even finely designed hardware can be spoiled by using it in the wrong place.

To harmonize with light, natural finished woodwork such as cypress, maple, oak, use antique brass or copper finish bronze, what is known as statuary bronze, dark green, or black hardware. Darker woods, such as mahogany, walnut, gumwood and dark oak, look best with bronze and dull brass finishes, but they also go well with bright brass finishes. The black and dark green finishes can be used with mission or Flemish oak, but not with the red colored woods. The nickel and silver finishes should be reserved for use with white and light enamels, although brass and dull brass can also be used effectively with them. Glass knobs go well with light finishes.—E. J. H.

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